ARPA 001   1996/1997

FY 1996/1997
Defense Budget Review
RDT&E Descriptive Summaries
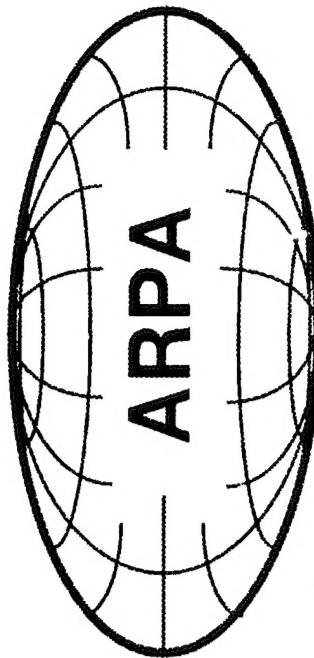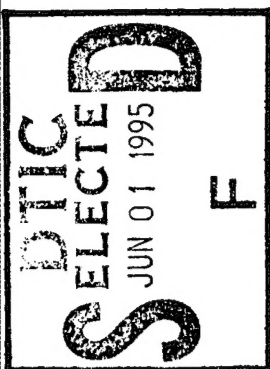
ARPA

September 1994

19950530 050

BUDGET JUSTIFICATION FOR PROGRAM ELEMENTS

OF THE

ADVANCED RESEARCH PROJECTS AGENCY (ARPA)

RESEARCH AND DEVELOPMENT PROGRAM

FY 1996/1997

SEPTEMBER 1994

ADVANCED RESEARCH PROJECTS AGENCY

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ADVANCED RESEARCH PROJECTS AGENCY

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(Cont'd)

SEP 0 8 1994

MEMORANDUM FOR THE SECRETARY OF DEFENSE

SUBJECT: FY 1996 Budget Estimate Submission

In response to the DoD Comptroller memorandum dated July 8, 1994, the attached budget exhibits are submitted.

Gary L. Dehman
Director

Attachments:
Exhibit R-1 (PE Level)
Exhibit R-2 (Budget Item Justification Sheets)
Object Classification Summary
PB-1 (FY96 Budget Estimates Summary)
PB-2/2A (Prog/Financing)
PB-4 (Schedule of Civ & Mil Personnel)
PB-5 (Pay Increase)
PB-15 (Consulting Services)
PB-22 (Mgmt Hdqtrs)
PB-28 (Environmental Proj)
PB-31R (Benefits)
PB-52A (Aeronautical Budget)
PB-52B (Space Budget)
PB-53 (Pay Raise)
OP-8 (Civilian Personnel Costs)
Civilian Workyear Report
Exhibit 43A (Information Technology)
Exhibit 44A (FY96 Budget Estimates)
SA (Security Activities)

Copy to: (with appropriate exhibits)
USD(A&T) Mailroom
USD(Policy)
ASD(FM&P)
ASD(C3I)
ASD(HA)
ASD(RA)
ASD(LA)
ATSD(PA)
JCS(J-8) *
BMDO
OMB
DoD(C) - P&S,OPS,INV,MILCON,P&FC,ITFM,FR&A, MI,PA&E

SECTION I

FUNDING SUMMARIES

ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
SUMMARY BY BUDGET ACTIVITY
($ in Thousands)

FY 1996 BUDGET ESTIMATE SUBMISSION

Budget Activity	Title	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate
1	Basic Research	85,889	87,554	90,352	93,064	95,444	99,386	103,531	110,286
2	Exploratory Development	756,933	823,881	796,871	802,554	897,501	894,085	1,013,830	1,133,625
3	Advanced Development	1,751,790	1,716,658	1,790,862	1,781,876	1,789,565	1,733,464	1,673,295	1,623,274
6	RDT&E Management Support	32,455	33,593	37,115	38,247	39,157	40,546	41,124	41,881
	TOTAL RDT&E - DIRECT	2,627,067	2,661,686	2,715,200	2,715,741	2,821,667	2,767,481	2,831,780	2,909,066
	Reimbursements	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
	TOTAL PROGRAM	2,637,067	2,671,686	2,725,200	2,725,741	2,831,667	2,777,481	2,841,780	2,919,066

Exhibit R-1

ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
DETAIL BY BUDGET ACTIVITY
($ in Thousands)

FY 1996 BUDGET ESTIMATE SUBMISSION

Element Code	Title	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate
1									
6.1	Basic Research	85,889	87,554	90,352	93,064	95,444	99,386	103,531	110,286
0601101E	Defense Research Sciences	85,889	87,554	90,352	93,064	95,444	99,386	103,531	110,286
2									
6.2	Exploratory Development	756,933	823,881	796,871	802,554	897,501	894,085	1,013,830	1,133,625
0602301E	Computing Systems & Communications Tech	321,216	420,832	372,852	371,934	407,522	399,260	451,891	486,527
0602702E	Tactical Technology	90,053	111,343	112,874	113,109	135,074	145,879	157,620	189,386
0602708E	Integrated Command & Control Tech	84,490	67,950	68,000	68,000	68,000	68,000	68,000	68,000
0602712E	Materials & Electronics Technology	261,174	223,756	243,145	249,511	286,905	280,946	336,319	389,712
3									
6.3	Advanced Development	1,751,790	1,716,658	1,790,862	1,781,876	1,789,565	1,733,464	1,673,295	1,623,274
0603226E	EEMIT	599,914	613,331	633,470	663,315	632,306	574,165	670,984	816,798
0603569E	Advanced Submarine Technology	43,839	25,261	20,973	24,311	28,449	34,430	46,230	54,530
0603570E	Defense Reinvestment	474,000	625,000	650,000	675,000	700,000	725,000	500,000	250,000
0603739E	Electronics Manufacturing Technology	377,551	342,129	375,520	404,550	408,810	384,869	441,081	483,946
0603744E	Advanced Simulation - National Guard	27,107	20,937	20,899	14,700	20,000	15,000	15,000	18,000
0603745E	Semiconductor Manufacturing Technology	89,250	90,000	90,000	0	0	0	0	0
0603746E	MARITIME Technology	38,750	0	0	0	0	0	0	0
0603747E	Electric Vehicles	46,250	0	0	0	0	0	0	0
0603748E	Natural Gas Vehicles	15,000	0	0	0	0	0	0	0
0603749E	Earth Conservancy	10,000	0	0	0	0	0	0	0
0603757E	Cooperative Agreement Program	6	0	0	0	0	0	0	0
0603889E	Counterdrug	30,123	0	0	0	0	0	0	0
6									
6.5	RDT&E Management Support	32,455	33,593	37,115	38,247	39,157	40,546	41,124	41,881
0605114E	Blacklite	4,875	4,875	4,778	4,730	4,683	5,000	5,000	5,000
0605898E	Management Headquarters (R&D)	27,580	28,718	32,337	33,517	34,474	35,546	36,124	36,881
	Total ARPA	2,627,067	2,661,686	2,715,200	2,715,741	2,821,667	2,767,481	2,831,780	2,909,066

Exhibit R-1

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ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
PROJECT LEVEL SUMMARY REPORT
($ in millions)

FY 1996 BUDGET ESTIMATE SUBMISSION

PE	PROJ	TITLE	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
61101E	CCS-02	INFORMATION SCIENCES	33.419	24.322	24.950	31.628	30.805	32.300	34.500	35.700
	ES-01	ELECTRONIC SCIENCES	28.725	41.782	43.336	36.362	36.578	39.233	43.778	47.533
	MS-01	MATERIALS SCIENCES	23.745	21.450	22.066	25.074	28.061	27.853	25.253	27.053
61101E		DEFENSE RESEARCH SCIENCES	85.889	87.554	90.352	93.064	95.444	99.386	103.531	110.286
62301E	ST-01	JASONS	1.240	1.227	1.218	1.203	1.190	1.200	1.200	1.200
	ST-11	INTELLIGENT SYSTEMS & SOFTWARE	68.357	89.723	91.832	95.709	132.394	120.307	138.407	156.707
	ST-19	HIGH PERFORMANCE COMPUTING	191.928	246.200	24?.547	250.757	255.260	257.503	289.034	303.484
	ST-22	SOFTWARE ENGINEERING TECHNOLOGY	37.415	40.223	19.562	19.205	18.678	20.250	23.250	25.136
	ST-23	COUNTER PROLIFERATION TECHNOLOGY	22.276	43.459	16.693	5.060	0.000	0.000	0.000	0.000
62301E		COMPUTING SYS & COMM TECHNOLOGY	321.216	420.832	372.852	371.934	407.522	399.260	451.891	486.527
62702E	TT-03	NAVAL WARFARE TECHNLOGY	26.421	33.383	44.969	56.241	70.410	58.687	59.407	70.173
	TT-04	ADVANCED LAND SYSTEMS TECHNOLOGY	15.244	33.239	34.302	26.125	30.136	50.000	54.686	66.686
	TT-05	ADVANCED TARGETING TECHNOLOGY	8.518	5.848	0.000	0.000	0.000	0.000	0.000	0.000
	TT-06	ADVANCED TACTICAL TECHNOLOGY	27.212	38.873	33.603	30.743	34.528	37.192	43.527	52.527
	TT-07	AERONAUTICS TECHNOLOGY	12.658	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62702E		TACTICAL TECHNOLOGY	90.053	111.343	112.874	113.109	135.074	145.879	157.620	189.386
62708E	IC-03	HIGH DEFINITION SYSTEMS	84.490	67.950	68.000	68.000	68.000	68.000	68.000	68.000
62708E		INTEGRATED COMMAND & CONTROL TECH	84.490	67.950	68.000	68.000	68.000	68.000	68.000	68.000
62712E	MPT-01	MATERIALS PROCESSING TECHNOLOGY	129.054	100.700	114.828	122.067	136.387	135.349	148.094	185.240
	MPT-02	ELECTRONICS PROCESSING TECHNOLOGY	94.332	94.323	83.821	85.710	99.291	100.214	136.179	155.972
	MPT-06	HIGH TEMP SUPERCONDUCTIVITY/HTSC	37.788	13.438	11.996	12.274	13.240	5.183	7.546	0.000
	MPT 07	MILITARY MEDICAL/TRAUMA CARE TECHNOLOGY	0.000	15.295	32.500	29.460	37.987	40.200	44.500	48.500
62712E		MATERIALS & ELECTRONICS TECHNOLOGY	261.174	223.756	243.145	249.511	286.905	280.946	336.319	389.712
63226E	EE-21	COMMAND & CONTROL INFORMATION SYSTEMS	0.500	18.712	28.586	25.700	30.000	39.237	41.687	46.034
	EE-24	ASTOVL/COTL COMMON AFFORD LIGHTWEIGHT FIGHTER	25.712	20.014	30.887	81.400	83.922	19.000	16.000	10.000
	EE-27	ADVANCED SPACE TECHNOLOGY PROGRAM	68.662	5.925	0.000	0.000	0.000	0.000	0.000	0.000
	EE-34	GUIDANCE TECHNOLOGY	10.809	10.870	26.328	29.844	32.000	17.000	17.000	17.000
	EE-36	ADVANCED SHIP/SENSOR SYSTEMS	17.180	15.885	16.613	33.707	45.614	51.550	53.050	68.050
	EE-37	ADVANCED SIMULATION	58.001	78.268	79.599	44.585	36.767	44.853	67.653	85.353
	EE-39	UNMANNED UNDERSEA VEHICLE SYSTEMS	23.850	18.839	16.950	17.570	17.395	18.115	21.115	26.115
	EE-40	CRITICAL MOBILE TARGETS	117.424	122.639	132.146	123.552	121.887	132.360	137.360	146.360
	EE-41	AIR DEFENSE INITIATIVE	24.642	38.642	43.770	45.036	55.029	55.989	66.989	88.989

ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
PROJECT LEVEL SUMMARY REPORT
($ in millions)

FY 1996 BUDGET ESTIMATE SUBMISSION

PE	PROJ	TITLE	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
	EE-45	GLOBAL GRID COMMUNICATIONS	19.209	45.187	45.493	44.842	43.592	27.916	22.935	24.549
	EE-46	DEFENSE SIMULATION INTERNET (DSI)	31.617	17.355	27.700	37.390	0.000	0.000	0.000	0.000
	EE-CLS	CLASSIFIED	202.308	220.995	185.398	194.000	189.100	197.145	247.195	323.348
63226E		EBMT	599.914	613.331	633.470	677.626	655.306	603.165	690.984	835.798
63569E	AS-01	ADVANCED SUBMARINE TECHNOLOGY	43.839	25.261	20.973	10.000	5.449	5.430	26.230	35.530
63570E	PT-01	DUAL USE TECHNOLOGY PARTNERSHIPS	150.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	PT-03	COMM/IL INTEGRATION PARTNERSHIPS	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	PT-04	REGIONAL TECHNOLOGY ALLIANCES	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	PT-06	AGILE MFG/ENTERPRISE INTEGRATION	35.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	PT-07	ADVANCED MATERIALS PARTNERSHIP	30.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	PT-08	ADVANCED MANUFACTURING TECH PARTNERSHIPS	30.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	PT-10	MFG ENGINEERING EDUCATION PROGRAM	24.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	PT-12	U.S. JAPAN MGMT TRAINING	5.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	PT-13	MARITECH	0.000	40.000	50.000	50.000	50.000	0.000	0.000	0.000
	PT-99	DEFENSE REINVESTMENT	0.000	585.000	600.000	625.000	650.000	725.000	500.000	250.000
63570E		DEFENSE REINVESTMENT	474.000	625.000	650.000	675.000	700.000	725.000	500.000	250.000
63739E	MT-01	MICROELECTRONICS MANUFACTURING	0.000	0.000	4.000	48.646	46.800	65.250	70.550	73.900
	MT-02	MMIC	79.631	22.274	0.000	0.000	0.000	0.000	0.000	0.000
	MT-03	INFRARED FOCAL PLANE ARRAY	41.429	44.809	37.661	19.400	0.000	0.000	0.000	0.000
	MT-04	ELECTRONIC MODULE TECHNOLOGY	115.274	128.325	156.812	141.823	152.089	161.872	207.564	231.534
	MT-05	TACTICAL DISPLAY SYSTEMS	9.263	15.030	25.801	23.169	29.735	27.546	30.500	40.500
	MT-06	MICROWAVE & ANALOG FRONT END TECHNOLOGY	0.000	24.169	28.399	33.133	54.981	55.201	62.467	68.012
	MT-07	CENTERS OF EXCELLENCE	23.837	23.000	14.000	10.000	0.000	0.000	0.000	0.000
	MT-08	MANUFACTURING TECHNOLOGY INITIATIVES	7.186	14.342	27.800	29.112	35.920	25.000	25.000	25.000
	MT-09	DUAL-USE DESIGN & MANUFACUTRING TECH	0.000	20.180	21.335	22.467	8.985	0.000	0.000	0.000
	MT-10	ADVANCED LITHOGRAPHY	57.931	10.000	40.000	61.800	65.300	50.000	45.000	45.000
	MT-11	COMPUTER AIDED ACQ AND LOGISTICS SUPPORT (CALS)	43.000	40.000	19.712	15.000	15.000	0.000	0.000	0.000
63739E		ELECTRONICS MANUFACTURING TECHNOLOGY	377.551	342.129	375.520	404.550	408.810	384.869	441.081	483.946
63744E	SM-01	ADVANCED SIMULATION - NATIONAL GUARD	27.107	20.937	20.899	14.700	20.000	15.000	15.000	18.000
63745E	EM-01	SEMICONDUCTOR MANUFACTURING TECHNOLOGY	89.250	90.000	90.000	0.000	0.000	0.000	0.000	0.000
63746E	MR-01	MARITIME TECHNOLOGY	38.750	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63747E	EV-01	ELECTRIC VEHICLES	46.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
PROJECT LEVEL SUMMARY REPORT
($ in millions)

FY 1996 BUDGET ESTIMATE SUBMISSION

PE	PROJ	TITLE	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
63748E	GV-01	NATURAL GAS VEHICLES	15.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63749E	EC-01	EARTH CONSERVANCY	10.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63757E	CO-01	COOPERATIVE AGREEMENT PROGRAM	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63889E	CD-01	COUNTERDRUG	30.123	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65114E	BL-01	BLACKLITE	4.875	4.875	4.778	4.730	4.583	5.000	5.000	5.000
65898E	MH-01	MANAGEMENT HEADQUARTERS (R&D)	27.580	28.718	32.337	33.517	34.474	35.546	36.124	36.881
		AGENCY TOTAL	2627.067	2661.686	2715.200	2715.741	2821.667	2767.481	2831.780	2909.066
	BA-01	TOTAL	85.889	87.554	90.352	93.064	95.444	99.386	103.531	110.286
	BA-02	TOTAL	756.933	823.881	796.871	802.554	897.501	894.085	1013.830	1133.625
	BA-03	TOTAL	1751.790	1716.658	1790.862	1781.876	1789.565	1733.464	1673.295	1623.274
	BA-06	TOTAL	32.455	33.593	37.115	38.247	39.157	40.546	41.124	41.881
		AGENCY TOTAL	2627.067	2661.686	2715.200	2715.741	2821.667	2767.481	2831.780	2909.066

ADVANCED RESEARCH PROJECTS AGENCY

RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE

OBJECT CLASSIFICATION

($ in Thousands)

		FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate
Personnel Compensation				
11.1	Full-Time Permanent	9,708	11,350	12,042
11.3	Other Than Full-Time Permanent	345	347	363
11.5	Other Personnel Compensation	439	517	538
11.8	Special Personnel Services Payments	3,570	4,970	5,215
	Total Personnel Compensation	14,062	17,184	18,158
Direct Obligations				
11.9	Total Personnel Compensation	14,062	13,288	14,570
12.1	Civilian Personnel Benefits	1,679	1,980	2,099
21.0	Travel and Transportation of Persons	3,076	3,181	3,242
23.1	Rental Payments to GSA	1,821	2,225	2,256
23.2	Rental Payments to Others	110	118	123
23.3	Communications, Utilities and Miscellaneous Charges	5,356	5,911	5,931
24.0	Printing and Reproduction	154	172	200
25.2	Other Services	2,957,181	2,582,060	2,628,937
25.1	Consulting Services	43,500	44,000	45,800
26.0	Supplies and Materials	355	367	374
31.0	Equipment	2,425	2,497	2,571
	Total Direct Obligations	3,029,719	2,655,799	2,706,103
Reimbursable Obligations				
25.0	Other Services	10,000	10,000	10,000
Total Obligations		3,039,719	2,665,799	2,716,103

ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
SUMMARY OF FY 1996 DEFENSE BUDGET ESTIMATES
($, in millions)

Appropriation Account Title	Direct Budget Plan (TOA)				Budget Authority				Outlays			
	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate
RDT&E, Defensewide	2,572	2,662	2,715	2,716	2,627	2,662	2,715	2,716	2,336	2,564	2,667	2,707

Exhibit PB-1

Research, Development Test and Evaluation, Defensewide
Advanced Research Projects Agency
Program and Financing (In Thousands of dollars)

9-Sep-94

Identification code: 97-0400-DE

	Budget Plan			
	Estimate FY 1994	Estimate FY 1995	Estimate FY 1996	Estimate FY 1997
Program by activities:				
Direct Program:				
01.000 Basic Research (6.1)	85,889	87,554	90,352	93,064
02.000 Exploratory Development (6.2)	756,933	823,881	796,871	802,554
03.000 Advanced Technology Development (6.3A)	1,751,790	1,716,658	1,790,862	1,781,876
06.000 Management Support (6.5)	32,455	33,593	37,115	38,247
Total Direct Program	2,627,067	2,661,686	2,715,200	2,715,741
R01.000 Reimbursable Program	10,000	10,000	10,000	10,000
Total Program	2,637,067	2,671,686	2,725,200	2,725,741
Financing:				
F11 010 New Federal Funds (-)	-10,000	-10,000	-10,000	-10,000
Total Budget Authority	2,627,067	2,661,686	2,715,200	2,715,741
Budget authority:				
F40.010 Appropriation EN/EST	2,611,041	2,661,686	2,715,200	2,715,741
F40.770 Reduction pursuant to P.L. 103-139(-)	-12,000			
F42.000 Transferred from other accounts	28,026			
Total Budget Authority	2,627,067	2,661,686	2,715,200	2,715,741

Exhibit PB-2A

8

Research, Development Test and Evaluation, Defensewide   9-Sep-94
Advanced Research Projects Agency
Program and Financing (In Thousands of dollars)

Budget Plan

Estimate
FY 1994

Identification code: 97-0400-DE

Program by activities:

  Direct Program:

01.000   Basic Research (6.1)   85,889
02.000   Exploratory Development (6.2)   756,933
03.000   Advanced Technology Development (6.3A)   1,751,790
06.000   Management Support (6.5)   32,455

          Total Direct Program   2,627,067

R01.000   Reimbursable Program   10,000

          Total Program   2,637,067

  Financing:

F11 010   New Federal Funds (-)   -10,000

           Total Budget Authority   2,627,067

Budget authority:
F40.010   Appropriation EN/EST   2,611,041
F40.770   Reduction pursuant to P.L. 103.139(-)   -12,000
F42.000   Transferred from other accounts   28,026
           Total Budget Authority   2,627,067

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
Advanced Research Projects Agency
Program and Financing (in Thousands of dollars)

9-Sep-94

Budget Plan

		Estimate FY 1995
Identification code: 97-0400-DE		
Program by activities:		
Direct Program:		
01.000	Basic Research (6.1)	87,554
02.000	Exploratory Development (6.2)	823,881
03.000	Advanced Technology Development (6.3A)	1,716,658
06.000	Management Support (6.5)	33,593
	Total Direct Program	2,661,686
R01.000	Reimbursable Program	10,000
	Total Program	2,671,686
	Financing:	
F11 010	New Federal Funds (-)	-10,000
	Total Budget Authority	2,661,686
	Budget Authority:	
F40.010	Appropriation EN/EST	2,661,686
F40.770	Reduction pursuant to P.L. 103.139(-)	
F42.000	Transferred from other accounts	
	Total Budget Authority	2,661,686

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide   9-Sep-94
Advanced Research Projects Agency
Program and Financing (in Thousands of dollars)

	Budget Plan
	Estimate FY 1996

Identification code: 97-0400-DE

Program by activities:

Direct Program:

01.000	Basic Research (6.1)	90,352
02.000	Exploratory Development (6.2)	796,871
03.000	Advanced Technology Development (6.3A)	1,790,862
06.000	Management Support (6.5)	37,115
	Total Direct Program	2,715,200
R01.000	Reimbursable Program	10,000
	Total Program	2,725,200

Financing:

| F11 010 | New Federal Funds (-) | -10,000 |
| | Total Budget Authority | 2,715,200 |

Budget Authority:

F40.010	Appropriation EN/EST	2,715,200
F40.770	Reduction pursuant to P.L. 103.139(-)	
F42.000	Transferred from other accounts	
	Total Budget Authority	2,715,200

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide   9-Sep-94
Advanced Research Projects Agency
Program and Financing (in Thousands of dollars)

		Budget Plan

		Estimate FY 1997

Identification code: 97-0400-DE

Program by activities:

Direct Program:

01.000	Basic Research (6.1)	93,064
02.000	Exploratory Development (6.2)	802,554
03.000	Advanced Technology Development (6.3A)	1,781,876
06.000	Management Support (6.5)	38,247
	Total Direct Program	2,715,741
R01.000	Reimbursable Program	10,000
	Total Program	2,725,741

Financing:

| F11 010 | New Federal Funds (-) | -10,000 |
| | Total Budget Authority | 2,715,741 |

Budget Authority:

F40.010	Appropriation EN/EST	2,715,741
F40.770	Reduction pursuant to P.L. 103.139(-)	
F42.000	Transferred from other accounts	
	Total Budget Authority	2,715,741

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
Advanced Research Projects Agency
Program and Financing (in Thousands of dollars)

9-Sep-94

		Obligation Summary			
Identification code: 97-0400-DE		Estimate FY 1994	Estimate FY 1995	Estimate FY 1996	Estimate FY 1997
Program by activities:					
Direct Program:					
01.000	Basic Research (6.1)	79,810	87,271	89,876	92,603
02.000	Exploratory Development (6.2)	818,732	812,500	801,463	801,588
03.000	Advanced Technology Development (6.3A)	2,091,898	1,722,629	1,778,248	1,783,403
06.000	Management Support (6.5)	39,279	33,399	36,516	38,055
	Total Direct Obligations	3,029,719	2,655,799	2,706,103	2,715,649
R01.000	Reimbursable Obligations	10,000	10,000	10,000	10,000
	Total Obligations	3,039,719	2,665,799	2,716,103	2,725,649
Financing:					
	Offsetting collections from:				
F11 010	New Federal Funds (-)	-10,000	-10,000	-10,000	-10,000
	Unobligated balance available, start of year:				
F21.020	For completion of prior year budget plans	-849,252	-446,600	-452,487	-461,584
	Unobligated balance available, end of year:				
F24.020	For completion of prior year budget plans	446,600	452,487	461,584	461,676
	Total Budget Authority	2,627,067	2,661,686	2,715,200	2,715,741
Budget authority:					
F40.010	Appropriation ENVEST	2,611,041	2,661,686	2,715,200	2,715,741
F40.770	Reduction pursuant to P.L. 103-139(-)	-12,000			
F42.000	Transferred from other accounts	28,026			
	Total Budget Authority	2,627,067	2,661,686	2,715,200	2,715,741

Exhibit PB-2A

Research, Development Test and Evaluation, Defensowide
Advanced Research Projects Agency
Program and Financing (in Thousands of dollars)

Obligations

Fiscal Year 1993 Estimate

Identification code: 97-0400-DE

1994 Estimate

Program by activities:

Direct Program:

01.000	Basic Research (6.1)	8,522
02.000	Exploratory Development (6.2)	190,478
03.000	Advanced Technology Development (6.3A)	637,911
06.000	Management Support (6.5)	12,341
	Total Direct Obligations	849,252
	Total Obligations	849,252

Financing:
Unobligated balance available, start of year:

F21.020	For completion of prior year budget plans	-849,252
	Total Budget Authority	0

Exhibit PB-2A

Research, Development Test ...d Evaluation, Defensewide
Advanced Research Projects Agency
Program and Financing (in Thousands of dollars)

Identification code: 97-0400-DE

| | | Obligations | |
| | | Fiscal Year 1994 Estimates | |
		1994 Est.	1995 Est.
Program by activities:			
	Direct Program:		
01.000	Basic Research (6.1)	71,288	14,601
02.000	Exploratory Development (6.2)	628,254	128,679
03.000	Advanced Technology Development (6.3A)	1,453,987	297,803
06.000	Management Support (6.5)	26,938	5,517
	Total Direct Obligations	2,180,467	446,600
R01.000	Reimbursable Obligations	10,000	
	Total Obligations	2,190,467	446,600
	Financing:		
F11.010	New Federal Funds (-)	-10,000	
F21.020	Unobligated balance available, start of year: For completion of prior year budget plans		-446,600
F24.020	Unobligated balance available, end of year: For completion of prior year budget plans	446,600	
	Total Budget Authority	2,627,067	
	Budget authority:		
F40.010	Appropriation EN/EST	2,611,041	
F40.770	Reduction pursuant to P.L. 103-139(-)	-12,000	
F42.000	Transferred from other accounts	28,026	
	Total Budget Authority	2,627,067	

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
Advanced Research Projects Agency
Program and Financing (in Thousands of dollars)

Identification code: 97-0400-DE

		Obligations Fiscal Year 1995 Estimates	
		1995 Est.	1996 Est.
Program by activities:			
Direct Program:			
01.000	Basic Research (6.1)	72,670	14,884
02.000	Exploratory Development (6.2)	683,821	140,060
03.000	Advanced Technology Development (6.3A)	1,424,826	291,832
06.000	Management Support (6.5)	27,882	5,711
	Total Direct Obligations	2,209,199	452,487
R01.000	Reimburseable Obligations	10,000	
	Total Obligations	2,219,199	452,487
Financing:			
F11.010	New Federal Funds (-)	-10,000	
	Unobligated balance available, start of year:		
F21.020	For completion of prior year budget plans		-452,487
	Unobligated balance available, end of year:		
F24.020	For completion of prior year budget plans	452,487	
	Total Budget Authority	2,661,686	
Budget Authority:			
F40.010	Appropriation EN/EST	2,661,686	
F40.770	Reduction pursuant to P.L. 103-139(-)		
F42.000	Transferred from other accounts		
	Total Budget Authority	2,661,686	

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
Advanced Research Projects Agency
Program and Financing (in Thousands of dollars)

Identification code: 97-0400-DE

| | | Obligations | |
| | | Fiscal Year 1996 Estimates | |
		1996 Est.	1997 Est.
Program by activities:			
Direct Program:			
01.000	Basic Research (6.1)	74,992	15,360
02.000	Exploratory Development (6.2)	661,403	135,468
03.000	Advanced Technology Development (6.3A)	1,486,416	304,446
06.000	Management Support (6.5)	30,805	6,310
	Total Direct Obligations	2,253,616	461,584
R01.000	Reimbureable Obligations	10,000	
	Total Obligations	2,263,616	461,584
Financing:			
F11 010	New Federal Funds (-)	-10,000	
F21.020	Unobligated balance available, start of year: For completion of prior year budget plans		-461,584
F24.020	Unobligated balance available, end of year: For completion of prior year budget plans	461,584	
	Total Budget Authority	2,715,200	
Budget Authority:			
F40.010	Appropriation EN/EST	2,715,200	
F40.770	Reduction pursuant to P.L. 103-139(1)		
F42.000	Transferred from other accounts		
	Total Budget Authority	2,715,200	

Exhibit PB-2A

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Research, Development Test, and Evaluation, Defensewide
Advanced Research Projects Agency
Program and Financing (in Thousands of dollars)

Obligations

Fiscal Year 1997 Estimates

1997 Est.

Identification code: 97-0400-DE

Program by activities:

Direct Program:

01.000	Basic Research (6.1)	77,243
02.000	Exploratory Development (6.2)	666,120
03.000	Advanced Technology Development (6.3A)	1,478,957
06.000	Management Support (6.5)	31,745
	Total Direct Program	2,254,065
R01.000	Reimbursable Program	10,000
	Total Program	2,264,065

Financing:

F11 010	New Federal Funds (-)	-10,000
F21.020	Unobligated balance available, start of year: For completion of prior year budget plans	
F24.020	Unobligated balance available, end of year: For completion of prior year budget plans	461,676
	Total Budget Authority	2,715,741

Budget Authority:

F40.010	Appropriation EN/EST	2,715,741
F40.770	Reduction pursuant to P.L. 103-139(1)	
F42.000	Transferred from other accounts	
	Total Budget Authority	2,715,741

Exhibit PB-2A

SECTION II

MODERNIZATION AND INVESTMENT

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Defense Research Sciences	**85,889**	**87,554**	**90,352**	**93,064**	**95,444**	**99,386**	**103,531**	**110,286**	**Continuing**	**Continuing**
Information Sciences CCS-02	33,419	24,322	24,950	31,628	30,805	32,300	34,500	35,700	Continuing	Continuing
Electronic Sciences ES-01	28,725	41,782	43,336	36,362	36,578	39,233	43,778	47,533	Continuing	Continuing
Materials Sciences MS-01	23,745	21,45/	22,066	25,074	28,061	27,853	25,253	27,053	Continuing	Continuing

(U) **Mission Description:** The Defense Research Sciences program element is budgeted in the Basic Research Budget Activity because it provides the technical foundation for long-term improvements through the discovery of new phenomena and the exploration of the potential of such phenomena for military, national security and commercial applications. It supports the scientific study and experimentation that is the basis for more advanced knowledge and understanding in information, electronic and materials sciences.

(U) The Information Sciences project supports the scientific study and experimentation that is the basis for more advanced knowledge in software technology, intelligent systems technology, human-computer interaction technology, facets of microelectronic sciences, and varied aspects of high performance computing.

(U) The Electronic Sciences project explores and demonstrates electronic and optoelectronic device, circuit, and processing concepts that will provide: (1) new technical options for future electronic and optical systems used in information transmission, gathering and processing; and (2) a substantial increase in performance and cost reduction per function.

(U) The Materials Sciences project is concerned with the development and exploitation of: biosensors for biological warfare (CBW) defense; development of high power/energy density electrochemical power sources (batteries and fuel cells). Other areas of focus are research on field-driven physicochemical and bioremediation tools for remediation of toxic chemical waste, waste source reduction for DoD-relevant manufacturing processes, and training of DoD personnel in hazardous waste management. In addition research is focused on basic concepts for development of holographic data storage systems, advanced magnetic materials and devices, and sequence specific heteropolymers for countering chemical warfare agents.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

		DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E

COST *(In Thousands)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Information Sciences CCS-02	33,419	24,322	24,950	31,628	30,805	32,300	34,500	35,700	Continuing	Continuing

(U) **Mission Description:** This project supports the scientific study and experimentation that is the basis for more advanced knowledge and understanding in Information Sciences related to long-term national security and commercial needs.

(U) Software technology develops advanced concepts for methods and tools to produce high assurance software, language concepts that facilitate the rapid specification and evolution of systems, and techniques to manage shared complex structured data objects in larger heterogeneous, distributed information systems. Intelligent systems technology focuses on advanced techniques for knowledge representation, reasoning, and machine learning to enable computer understanding of spoken and written language and images, to advance methods for planning, scheduling, and resource allocation. Human computer interaction technology focuses on design methods and enabling technology for more natural interaction between people and computers. Microelectronic science calibrates fundamental concepts to produce reliable, testable, and high performance design. High Performance Computing (HPC) science generates concepts and methods for validating and verifying design components, and unique approaches to rapidly develop high performance libraries across multiple HPC architectures.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Developed benchmark problems, metrics, and test data sets for advanced research in information sciences. ($2.4M)
- Developed advanced concepts for machine learning, automated reasoning, and knowledge representation for spoken language understanding, written language understanding, image understanding and large-scale planning, scheduling, and resource allocation methods. ($1.7M)
- Explored the utility of advanced information processing methods in spoken language understanding, written language understanding, and automated planning systems. ($5.7M)
- Developed design concepts for interactive, dialogue-based human computer interaction. ($4.2M)
- Developed process model approaches for prototyping large-scale software systems. ($1.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 1 Basic Research	Defense Research Sciences, PE 0601101E, Project CCS-02

- Developed advanced concepts for image understanding, high assurance, and software system composition. ($5.2M)

- Developed advanced concepts for heterogeneous, distributed software system architectures and tools to support construction and maintenance of software systems. ($2.9M)

- Developed design concepts of advanced components needed for highly reliable computing systems including mobile, high performance, and graphical systems. ($6.0M)

- Developed advanced concepts for high performance libraries to support multiple parallel architectures and integrated with compiler technology. ($4.3M)

(U) FY 1995 Program:

- Experimentally evaluate advanced information processing methods in spoken language understanding, written language understanding, and automated planning systems. ($5.6M)

- Develop initial tool kits for interactive, dialogue-based human computer interaction and demonstrate them in a clinical environment. ($5.0M)

- Develop initial language-based methods for image understanding, high assurance, and software engineering system composition. ($5.7M)

- Experimentally evaluate process model approaches for prototyping large-scale software environments systems. ($1.0M)

- Develop initial planning and decision aids prototypes for heterogeneous, distributed software system architectures and tools to support construction and maintenance of advanced intelligent systems. ($4.1M)

- Experimentally evaluate library research that supports multiple parallel architectures. ($1.9M)

- Demonstrate health information network using South Florida Clinic. ($1.0M)

(U) FY 1996 Program:

- Refine and enhance benchmark problems, metrics, and test data sets and conduct experimental evaluations involving multiple intelligent systems and software engineering foundations technologies, utilizing knowledge acquisition. ($6.4M)

- Enhance advanced information processing methods in spoken language understanding, written language understanding and automated planning systems. ($3.9M)

- Experimentally evaluate tool kits for interactive, dialogue-based human computer interaction. ($5.0M)

- Experimentally evaluate language-based methods for image understanding, high assurance, and software environments system composition. ($2.7M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 1 Basic Research	Defense Research Sciences, PE 0601101E, Project CCS-02	September 1994

- Experimentally evaluate planning and decision aids prototypes for heterogeneous, distributed software system architectures and tools to support construction and maintenance of advanced intelligent systems. ($2.4M)
- Refine and begin experimental evaluation of design technology to include high performance computational prototyping of systems. ($4.6M)

(U) FY 1997 Program:

- Develop initial tools and tool kits for development and evaluation of highly interactive, agent and dialogue-based human computer interactions. ($4.6M)
- Demonstrate a multi-language architecture definition and simulation framework for software environments composition. ($5.5M)
- Provide suite of tools to generate focused software, on demand, for image understanding. ($1.6M)
- Develop new methods for integrating diverse products into heterogeneous National Information Infrastructure (NII) applications. ($4.5M)
- Advance the capabilities of spoken and written language understanding to solve real-world problems and provide widely usable human-computer interface functionality. ($5.9M)
- Extend and evaluate large-scale statistical modeling, machine learning, and knowledge representation methods for spoken and written language understanding. ($1.5M)
- Experimentally evaluate and develop prototypes for the NII in the area of heterogeneous, distributed software engineering foundations for system architectures and tools to support construction and maintenance of advanced software and intelligent systems. ($5.9M)
- Develop hub formalization that will infuse existing programming languages with new advances in formal methods. ($1.0M)
- Continue the experimental evaluation of design technology for high performance computational prototyping of systems. ($6.1M)

(U)

Program Change Summary:	(In Millions)	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget		33.7	24.3	26.0	31.6
Current Budget		33.4	24.3	25.0	31.6

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE September 1994
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project CCS-02	

(U) **Change Summary Explanation:**

FY 1994-96 Reflects minor repricing.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**   N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research							R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E		
COST *(In Thousands)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Electronic Sciences ES-01	28,725	41,782	43,336	36,362	36,578	39,233	43,778	47,533	Continuing	Continuing

(U) **Mission Description:** This project explores and demonstrates electronic and optoelectronic device, circuit, and processing concepts that will provide: (1) new technical options for future electronic and optical systems used in information transmission, gathering and processing; and (2) a substantial increase in performance and cost reduction per function. Research areas include new electronic and optoelectronic device and circuit concepts, innovative optical arrayed interconnects and smart pixels, optical memory research, artificial neural network (ANN) research, and microelectromechanical systems (MEMS) technology. This basic research project creates the vital new concepts for advanced electronic, optoelectronic, and MEMS components to meet future DoD needs.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Determined applicability of lattice gas computing architecture to nanoelectronics. ($1.0M)
- Demonstrated self-assembled molecular wiring of 10 nanometer lengths. ($.7M)
- Delivered process simulator computer program with two-dimensional capability for GaAs and silicon-based devices. ($2.0M)
- Demonstrated fabrication of abrupt semiconductor interfaces using limited reaction processing. ($1.0M)
- Fabricated array of <15 nm channels with <25 nm spacing using nanochannel glass. ($.5M)
- Completed design for compressed-size, two-dimensional edge detector using nanoelectronics. ($1.0M)
- Demonstrated fabrication steps for lateral resonant tunneling. ($1.3M)
- Explored applicability of single electron transistors to ultra-dense logic and memory. ($1.0M)
- Demonstrated nanometer scale critical dimensions of devices grown on patterned substrates. ($.5M)
- Fabricated SiGeC samples to explore use in silicon-based nanoelectronics. ($.4M)
- Demonstrated patterning using self-assembled monolayers. ($.3M)
- Demonstrated 10X reduction in ultra-low-power laser size. ($2.0M)
- Demonstrated components for chip-to-chip and on-chip optical interconnects. ($2.9M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 1 Basic Research	Defense Research Sciences, PE 0601101E, Project ES-01

- Developed semiconductor laser diodes with minimum relative intensity noise (RIN) for analog modulation. ($1.0M)
- Investigated charge transport across quantum well interface for high speed photonic operation. ($1.0M)
- Investigated crystalline and quantum well nonlinear polymer devices. ($1.0M)
- Developed biologically-based neural network algorithms for early vision processing. ($1.2M)
- Developed novel neural network techniques for pattern recognition, temporal processing, and adaptive control applications. ($1.7M)
- Developed microsensor CAD/CAM and process simulation tools and initiate multi-project, common fabrication infrastructure for Microelectromechanical Systems (MEMS). ($8.3M)

(U) FY 1995 Program:

- Initiate Phase II of the Nanoelectronics program. Thrusts will include combined nanoelectronics and conventional electronics, silicon-based nanoelectronics, chemical self-assembly, and molecular beam epitaxy (MBE) process control and other fabrication techniques. ($15.5M)
  - Demonstrate power reduction by a factor of five through the combination of nanoelectronics and conventional devices.
  - Explore compressed circuitry using multi-valued logic and nanoelectronics.
  - Demonstrate improved process control of MBE, controlling temperature to within 2 degrees and thickness to within 1 nanometer.
  - Determine optimum materials systems for fabricating silicon-based nanoelectronics.
  - Develop chemical self-assembly techniques for electronically active materials.
  - Develop voltage measurement capability suited to nanoelectronics (better than 100 nanometer spatial resolution and 50GHz temporal resolution).
  - Explore compressed circuitry using multi-valued logic and nanoelectronics.
  - Demonstrate utility of nanochannel glasses in fabricating nanoelectronic structures.
  - Utilize nanostructures for high resolution electron and ion-beam technology.
  - Demonstrate three-terminal lateral resonant tunneling transistor.
  - Demonstrate feasibility of magnetic memory with nanometer scale devices.
- Develop material for short wavelength light emitters and demonstrate green/blue light and nonlinear optical material for optical modulation and switching emission. ($2.0M)
- Demonstrate smart pixel arrays capable of input-output and simple logic functions. ($3.0M)
- Demonstrate optical interconnect for shared memory application. ($3.0M)
- Develop functional optoelectronic modules for free space optoelectronic processor. ($2.8M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Defense Research Sciences,
BA 1 Basic Research	PE 0601101E, Project ES-01

- Develop low-power, high-speed analog neural network hardware for accelerating early vision processing algorithms. ($1.5M)

- Establish theoretical foundations for specific neural network architectures, and develop improved architectures for pattern recognition, temporal processing, and adaptive control applications. ($1.2M)

- Develop high-yield, high-uniformity fabrication processes for microelectromechanical system (MEMS) devices and merge MEMS with related fabrication technologies in optics, optoelectronics and microwave devices and initiate low-bandwidth, large-scale MEMS-based sensor networks. ($7.8M)

- Initiate low-power electronics technology. ($5.0M)

(U) FY 1996 Program:

- Continue nanoelectronics program with emphasis on combined nanoelectronics and conventional electronics, silicon-based nanoelectronics, chemical self-assembly, and molecular beam epitaxy (MBE) process control and other fabrication techniques. ($13.4M)

  - Develop designs with improved power, performance, and lowered part count compared with circuits using only conventional devices.
  - Explore applications of multi-valued logic to special purpose processing.
  - Demonstrate compressed-area multi-valued logic adder with binary input and output.
  - Demonstrate functional silicon-based nanoelectronic devices.
  - Demonstrate submicron pattern transfer using low-cost elastopolymeric stamps and explore use of self-assembled monolayers for nanoelectronics and for protection of semiconductor wafers during processing.
  - Design prototype hardware and improve user interface software for MBE process control.
  - Develop methods for converting electrical designs to processing protocols.
  - Continue development of lateral patterning techniques.

- Demonstrate materials and device designs to achieve ultra low threshold, high speed direct modulated laser and demonstrate high speed optoelectronic technologies for optical switching applications. ($4.6M)

- Demonstrate photonic device applications of non-semiconductor thin films doped with optically active ions and explore material technologies for monithically integrated optoelectronic components. ($4.0M)

- Fabricate electron-beam microcolumn. ($1.4M)

- Initiate development of gallium-nitride based LED's and lasers for green/blue and ultraviolet. ($5.6M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 1 Basic Research	Defense Research Sciences, PE 0601101E, Project ES-01

- Continue development of high-density integrated electrical/mechanical systems along with requisite developments of CAD tools, materials data base, test and characterization methods, and manufacturing processes. ($7.3M)

- Develop CAD tools incorporating component and subsystem power estimation and algorithm driven, low power circuit synthesis rules. ($6.0M)

- Assess thermal response characteristics of thin film ferroelectric material for improved sensitivity uncooled infrared detectors. ($1.0M)

(U) FY 1997 Program:

- Continue the nanoelectronics program with emphasis on the following thrusts: combined nanoelectronics and conventional electronics, silicon-based nanoelectronics, chemical self-assembly, and molecular beam epitaxy (MBE) process control and other fabrication techniques. ($11.3M)
  - Explore concepts for ultra high density memory, design combined nanoelectronic and conventional circuits for information processing and demonstrate 20X increase in speed-power performance of mux/demux circuits.
  - Optimize silicon-based nanoelectronics fabrication and device design.
  - Demonstrate potential for chemical self-assembled films' use in nanoelectronics.
  - Demonstrate precision process control of semiconductor heterostructures for advanced nanoelectronic devices.

- Demonstrate monolithically integrated optoelectronics for information processing and demonstrate feasibility of three-dimensional optically addressed memory. ($5.0M)

- Determine the limits of high speed modulation of semiconductor lasers. ($2.0M)

- Demonstrate precision process control of semiconductor heterostructures for advanced optical devices. ($2.8M)

- Develop and demonstrate blue ultraviolet light-emitting diodes in gallium-nitride system and identify relationship between lifetime and defect density. ($5.4M)

- Fabricate small (5X5) infrared sensitive arrays as verification of material properties. ($2.0M)

- Explore thermal and electric conductivity properties of thermo-electric materials for use in battery operated infrared detector coolers. ($1.0M)

- Develop and demonstrate efficient low-voltage conversion/distribution circuits and self-regulating, use-driven power allocation systems. ($6.8M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project ES-01

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	28.9	41.9	42.1	40.8
Current Budget	28.7	41.8	43.3	36.4

(U) **Change Summary Explanation:**

FY 1994-96 Minor repricing adjustments.
FY 1997   Transfer of funds to a higher priority program in PE 0601101E, Materials Sciences project (MS-01).

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:** N/A

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research		R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E						
COST *(In Thousands)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Materials Sciences MS-01	23,745	21,450	22,066	25,074	28,061	27,853	25,253	27,053	Continuing	Continuing

(U) **Mission Description:** This project is concerned with the development and exploitation of: biosensors for battlefield trauma care; high volume production of long-chain designer polymer molecules for passive chemical and biological warfare (CBW) defense; development of high power/energy density electrochemical power sources (batteries and fuel cells). Other areas of focus are research on field-driven physicochemical and bioremediation tools for converting toxic chemical wastes, waste source reduction for DoD-relevant manufacturing processes, and training of DoD personnel in hazardous waste management. In addition, research is focused on basic concepts for development of holographic data storage systems.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Electrochemistry ($15.7M): Developed high energy density/power density electrochemical power sources for a variety of military applications. Utilized supercritical water oxidation to destroy DoD toxic wastes.
  - Demonstrated high efficiency direct oxidation fuel cell power module.
  - Demonstrated prototype rechargeable solid state military battery. Delivered 20 prototypes for evaluation.
  - Constructed supercritical water oxidation (SCWO) processor for destruction of toxic wastes.
  - Demonstrated both live agent, agent stimulant, and propellant destruction using SCWO technology.
  - Initiated a hazardous substance research centers program to develop technologies aimed at removing hazardous waste from DoD bases and facilities, and to train DoD and DOE personnel in hazardous waste management.
  - Initiated a program to develop a logistic fuel cell for mobile electric power. Evaluated fuel reformer catalysts and processor components.
- Biomedical ($6.6M): Utilized biological technologies to enhance various aspects of military medicine.
  - Initiated a program in medical technology concerned with developing medical sensors and the use of advanced information technologies to enhance battlefield trauma care.
  - Demonstrated binding affinity, reagent stability, and cellular uptake of oligonucleotide reagents for infections.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research	**DATE** September 1994
	R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project MS-01

- Plans reviewed and approved by Armed Services Biomedical Research Evaluation and Management (ASBREM).
- Developed computer simulation of human anatomy for training of military surgeons in surgical procedures for battlefield casualties.

• Optical materials ($1.4M): Developed aluminum-free laser diode arrays.

- Demonstrated multiple page fully digital holographic data storage system.

(U) FY 1995 Program:

• Electrochemistry ($9.7M): Concentrates on use of logistic fuels (hydro-carbon based) in advanced energy sources (fuel cells).

- Evaluate novel logistics fuel catalysts, electrolytes and electrodes.
- Develop logistic fuel cell components and demonstrate near ambient temperature operation.
- Construct a pilot plant, supercritical water oxidation reactor (1 gal./min.) and begin testing for the destruction of chemical warfare agents, propellants and other DoD hazardous wastes.

• Biomedical ($11.8M): Exploit technology base developments in microelectronics, sensors, communications, imaging and simulation to enhance far-forward combat casualty care. This project provides component and modular additions to the Personnel Status Monitor (PSM) under development in PE 0602712E, project MPT-07.

- Continue modular development of the personnel status monitor (PSM) to include secondary sensors of non-invasive blood chemistries; initial miniaturization of power supply and electronic packaging; involves field testing and evaluation. Development of field medical communication network of cellular and regional control units; integration of small antenna design; asynchronous transfer mode protocol and electronic firmware and software development.
- Develop advanced human health monitoring for the critical care pod and integrate with telecommunications throughout the battlefield over wireless network.
- Develop miniaturized direct digital imaging technologies; begin electronic miniaturization and packaging.
- Develop battlefield surgical simulation for injuries to the torso, including complex physiologic representation.
- Continue development of virtual environment for the individual soldier in order to test and evaluate the efforts of training, equipment, etc. on the health of the soldier.
- Develop and incorporate advanced manipulation and sensory feedback into a telepresence surgery system; explore methods for diminishing latency in tele-manipulation; field testing and evaluation.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 1 Basic Research	Defense Research Sciences, PE 0601101E, Project MS-01

(U) **FY 1996 Program:**

- **Electrochemistry.** ($10.0M)
  - Develop a high efficiency fuel reformer for fuel cell applications to process logistic fuel.
  - Demonstrate fuel cell operation using methanol with performance adequate for electric vehicle and soldier applications.
  - Test novel direct oxidation logistics fuel cell concept.

- **Biomedical.** ($2.8M)
  - Develop miniaturized, conformal design and rechargeable polymer power sources for the Personnel Status Monitor (PSM).
  - Develop pharmacologic mixture which results in suspended animation, meaningful for vital organs following battlefield trauma.

- **Heteropolymers.** ($3.5M)
  - Demonstrate high yield synthesis of long chain polymers that have specific sequences of 50-100 molecules.

- **Magnetic Materials and Devices.** ($2.2M)
  - Enhance magneto-resistance ratio at low magnetic fields for greater sensitivity of devices.

- **Bioremediation.** ($3.6M) Field-driven technology development for environmental cleanup of hazardous waste sites.
  - Quantify soil type and contaminant mixture effects on biodegration rates, bioavailability, and rate limiting process steps.
  - Characterize field sites.

(U) **FY 1997 Program:**

- **Electrochemistry.** ($10.0M)
  - Develop integrated fuel cell stack and reformer which operates on logistics fuel.
  - Demonstrate direct, liquid-feed methanol fuel cell stack operation with performance adequate for electric vehicles and soldiers.
  - Demonstrate high performance hydrogen/air fuel cell with a power density of 1 kw/kg.

- **Biomedical.** ($4.4M)
  - Develop knowledge based control algorithms for the PSM.
  - Develop "smart"-catheters for battlefield blood chemistry assessments.

- **Heteropolymers.** ($3.9M)

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 1 Basic Research

R-1 ITEM NOMENCLATURE
Defense Research Sciences,
PE 0601101E, Project MS-01

- Initiate synthesis of sequence specific heteropolymers to construct organophosphate "sponge" (used in countering chemical warfare agents).

- Magnetic Materials and Devices. ($1.5M)
  - Optimize performance of spin transistor for use in high density memory devices.

- Bioremediation. ($5.3M)
  - Complete bioremediation process design models, and implement cost models.
  - Conduct field evaluations of bioremediation processes.
  - Complete process design model validation and refinement.

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	23.9	21.5	22.0	20.6
Current Budget	23.7	21.5	22.1	25.1

(U) **Change Summary Explanation:**

FY 1994   Minor repricing.
FY 1996-97 Adjustments reflect the enhancement of efforts in Bioremediation.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:** N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

		DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Computing Systems and Communications Technology	321,216	420,832	372,852	371,934	407,522	399,260	451,891	486,527	Continuing	Continuing
JASON ST-01	1,240	1,227	1,218	1,203	1,190	1,200	1,200	1,200	Continuing	Continuing
Intelligent Systems & Software ST-11	68,357	89,723	91,832	95,709	132,394	120,307	138,407	156,707	Continuing	Continuing
High Performance Computing ST-19	191,928	246,200	243,547	250,757	255,260	257,503	289,034	303,484	Continuing	Continuing
Software Engineering Technology ST-22	37,415	40,223	19,562	19,205	18,678	20,250	23,250	25,136	Continuing	Continuing
Counterproliferation Technology ST-23	22,276	43,459	16,693	5,060	0	0	0	0	0	N/A

(U) **Mission Description:** This program element is budgeted in the Exploratory Development Budget Activity because it funds projects directed toward the application of advanced, innovative computing systems and communications technologies. These programs include:

(U) ARPA leadership of the Federal High Performance Computing and Communications Initiative to develop technologies to allow computer systems to function at a trillion operations per second and a billion bits per second networking to ensure availability for future defense needs. This technology will be incorporated into advanced applications to solve critical defense problems such as distributed C^3 systems.

(U) The efforts funded in the Intelligent Systems and Software project focus on the development of new information processing technology concepts that lead to fundamentally new software and intelligent system capabilities. Emphases are in autonomous systems, interactive problem solving, source integration, software development, and manufacturing automation and design engineering.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E

(U)   The Software Engineering Technology project supports the Software Engineering Institute (SEI) and Software Technology for Adaptable, Reliable Systems (STARS). SEI works to transition, introduce and promulgate modern software in the defense industry. The STARS program develops large-scale software products that have commercial as well as military capabilities.

(U)   The Counterproliferation Technology project addresses a national effort for a Comprehensive Test Ban (CTB) Verification Readiness Program to enhance U.S. surveillance capabilities for monitoring worldwide nuclear explosions and a focused program to develop technologies for detecting the production, testing and storage of nuclear materials and weapons.

(U)   The JASON Group supports studies for the national security community.

(U)   The programs contained in Projects ST-11, ST-19 and ST-22 reflect the Department's initiative to support dual-use technologies.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology, PE 0602301E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
JASON ST-01	1,240	1,227	1,218	1,203	1,190	1,200	1,200	1,200	Continuing	Continuing

(U) **Mission Description:** This project supports the JASONs, an independent group of distinguished scientists and technical researchers that provides analysis of critical National Security issues. JASON membership is carefully balanced to provide a wide spectrum of scientific expertise and technical analysis in theoretical and experimental physics, materials, information sciences, and other allied disciplines. The JASON process ensures senior government leaders have available the full range of U.S. academic expertise on issues critical to National Security involving all classified and unclassified information.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

* Conducted extensive technical investigations in areas such as: advanced sensors for surveillance and strike; shallow water acoustic Anti-Submarine Warfare (ASW); advanced concepts for lightweight survivable combat vehicles; advanced materials; and signal processing.

* Specific conclusions on counterproliferation, radar technology and automated target recognition had provided the foundation for the definition of research objectives and programs in these areas.

(U) FY 1995 Program:

* Continue investigations involving: structural acoustics; advanced land combat vehicles; precision strike; ASW; nuclear weapon proliferation; counterproliferation; joint U.S.-Russian space exploration and global surveillance and communications.

(U) FY 1996 Program:

* Continue studies in: nuclear and chemical weapons proliferation, precision strike weapons, global surveillance and communications; counter drug surveillance techniques; shallow water ASW; and advanced signal processing.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-01

(U) FY 1997 Program:
- Continue studies in: counterproliferation of nuclear, chemical and biological weapons, precision deep strike weapons, counter drug and law enforcement surveillance techniques; third world shallow water ASW: advanced sensor technologies; and global surveillance and intelligence.

(U) **Program Change Summary:**   (In Millions)

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	1.2	1.2	1.2	1.2
Current Budget	1.2	1.2	1.2	1.2

(U) **Change Summary Explanation:** No change.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:** N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY			R-1 ITEM NOMENCLATURE			DATE September 1994		
RDT&E, Defensewide BA 2 Exploratory Development			Computing Systems and Communications Technology, PE 0602301E					

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Intelligent Systems and Software ST-11	68,357	89,723	91,832	95,709	132,394	120,307	138,407	156,707	Continuing	Continuing

(U) **Mission Description:** Develop new information processing technology concepts that lead to fundamentally new software and intelligent systems capabilities. This will enable advanced information systems (involving both humans and computers) to more effectively accomplish decision-making tasks in stressful, time sensitive situations and create efficient software systems supporting computer and software intensive defense systems. Major areas of technical emphasis are in: (a) intelligent systems (artificial intelligence) including autonomous systems, image understanding, interactive problem solving and intelligent integration of information from heterogeneous sources; (b) software development technology including languages, algorithms, data and object bases, domain specific software architectures, software prototype technology, software design tools, software reuse, and advanced software engineering environments; (c) manufacturing automation and design engineering, including the development of advanced software systems which support sharing of engineering knowledge, advanced product and process design representations, integrated product and process design, software tools for design process management, manufacturing process planning, manufacturing process control and demonstrations; and (d) organizing resources to obtain access to multiple systems and decision aids that provide logistical information when it is needed and where it is needed.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Developed test case scenarios and internet accessible software testbeds that typify the type of advanced information processing requirements in DoD systems such as autonomous systems, command and control, and manufacturing systems. ($9.4M)

- Experimentally evaluated the integration of multiple intelligent systems and software technologies in an autonomous vehicle. ($.9M)

- Released the beta version of the Image Understanding Environment (IUE) and developed advanced methods for vision guided navigation, photo-intelligence cartographic modelling, and target detection and identification. ($15.6M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology, PE 0602301E, Project ST-11

- Developed initial capabilities for human-aided machine translation, document understanding, and robust speech understanding in adverse acoustic conditions. ($12.1M)
- Developed advanced real-time planning and control algorithms. ($3.8M)
- Developed knowledge-based decision aids to support the rapid construction of crisis action plans. ($3.8M)
- Developed advanced methods for information fusion, aggregation, summarization, and explanation. ($3.7M)
- Developed initial language-based methods for describing domain-specific software architecture and tools that facilitated composing a software system based on a domain specific architecture. ($6.7M)
- Developed initial advanced software environment that supports tools for composing softwares, integration, and software development and testing using animation techniques. ($3.1M)
- Developed fundamental evaluation and design concepts to support highly distributed, wide bandwidth information processing applications that require persistent objects. ($3.4M)
- Enhanced agent-based architectures for sharing design knowledge, manufacturing process planning, and manufacturing control. ($3.4M)
- Integrated persistent object base, case-based reasoning and physics-based simulation models in an integrated product/process design (IPPD) testbed. ($2.5M)

(U) FY 1995 Program:

- Experimentally evaluate the integration of multiple advanced intelligent systems and software technologies in multiple autonomous vehicles. ($4.0M)
- Upgrade the Image Understanding Environment (IUE) based on FY 1994 evaluations and develop prototype implementations of advanced methods for vision guided navigation, cartographic modelling, photo-intelligence target detection and identification. ($10.8M)
- Develop initial prototype implementations for human-aided machine translation, document understanding, and robust speech understanding in adverse acoustic conditions. ($11.8M)
- Develop initial prototype implementations of advanced real-time planning and control algorithms. ($4.3M)
- Enhance knowledge based planning and decision aids to support the rapid construction of multiple crisis action plans. ($7.8M)
- Develop initial prototype implementations of advanced intelligent integration methods for information fusion, aggregation, summarization and explanation. ($5.1M)
- Experimentally evaluate language-based methods for describing domain specific software architecture and tools that facilitate composing a software system based on a domain specific architecture. ($4.6M)
- Experimentally evaluate advanced software environment that supports composition tools for composing softwares, integration, and software development and testing using animation techniques. ($4.3M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Computing Systems and Communications Technology,
BA 2 Exploratory Development	PE 0602301E, Project ST-11

- Develop prototype to support highly distributed, wide bandwidth information processing applications that require persistent objects. ($5.3M)

- Enhance the IPPD testbed to include intelligent product and process representations and a scalable framework to invoke and attach design tools for electro-mechanical systems. ($4.0M)

- Develop information infrastructure services for manufacturing, including network access to engineering analysis and rapid prototyping services. ($6.0M)

- Experimentally evaluate agent-based architectures for sharing design knowledge, manufacturing process planning, and manufacturing control. ($7.3M)

- Initiate study measuring the impact of technology aids on teacher, staff, and student performance. Evaluate technology in selected teaching clusters and use model school districts (such as Val Verde & Port Hueneme) to transfer high technology concepts of use to other clusters. ($3.8M)

- Initiate development of a modular testbed for human computer interaction technology insertion for testing, evaluating and demonstrating. ($5.7M)

- Support software initiatives at the Software Institute Johnstown. ($4.9M)

(U) FY 1996 Program:

- Enhance advanced image understanding methods for vision guided navigation, cartographic modelling, and target detection and identification, and facilitate transition and adoption of the resulting technology. ($10.0M)

- Experimentally evaluate implementations for human-aided machine translation, document understanding, and robust speech understanding in adverse acoustic conditions. ($9.4M)

- Experimentally evaluate implementations of advanced real-time planning and control algorithms. ($4.2M)

- Evaluate knowledge-based planning and decision aids to support the rapid construction of multiple crisis action plans in an operational exercise. ($10.3M)

- Experimentally evaluate advanced intelligent integration methods for information fusion, aggregation, summarization, and explanation. ($7.8M)

- Experimentally evaluate prototype implementations to support highly distributed, wide bandwidth information processing applications that require persistent objects. ($3.7M)

- Experimentally evaluate scalable machine intelligent methods for machine learning, automated reasoning and real-time problem solving. ($10.0M)

- Expand network design and manufacturing services to include factory simulation and reusable product/process design libraries. ($9.5M)

- Continue the human computer interaction heterogenous testbed product development and insertion. Test, evaluate and demonstrate enhancements to the user community. ($9.7M)

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	DATE
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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology, PE 0602301E, Project ST-11

- Define consensus Architecture Description Language and Interactive Architecture Synthesis Tool for complex system. ($4.5M)
- Develop Knowledge Rover Proof of Principle; Human Computer Interaction testbed; capability to integrate Defense Logistics Agency (DLA) sustainment models into DoD wide logistics databases and models; reusable Logistics Anchor Desk (LAD) Software Framework services and information available to other extension service providers in the nationwide network; and demonstrate the feasibility of mechanisms to increase the non-Federal cost share for operating the regional satellites. ($4.8M)
- Develop a software environments rapid construction facilities for robust software and intelligent systems technology prototypes. ($3.0M)
- Support software initiatives at the Software Institute, Johnstown. ($4.9M)

(U) FY 1997 Program:

- Continue development of human-computer interaction, heterogeneous testbed products and insertion. Test, evaluate and demonstrate enhancements to the developer and user communities. ($11.7M)
- Pursue software engineering of real-time systems that would lead to a significant reduction in development costs, and experimentally evaluate Real Time Planning and Control algorithms for multi-agent systems. ($5.9M)
- Evaluate distributed design tools and demonstrate multi-agent manufacturing process planning and manufacturing control. ($22.7M)
- Investigate the use of context, collateral text, and other knowledge to direct image understanding for intelligence applications. ($4.6M)
- Develop modular Human Language Technologies to support easy, low-cost, rapid technology transfer and application development for Document Understanding, Machine Translation, and Speech Understanding. ($2.1M)
- Develop, in the Intelligent Integration of Information area, formal languages to express, manipulate and assemble the primitives which are viable and implementable. ($8.7M)
- Transition planning and decision aids tools to appropriate ATDs - test and evaluate. ($7.0M)
- Extend Architecture Description Language for complex systems to include performance and context information. ($12.0M)
- Complete Knowledge Rover Proof of Principle; complete reusable LAD Software Framework; complete capability to integrate DLA sustainment models into Army, Navy, and TRANSCOM and DLA logistics databases and models. ($9.3M)
- Demonstrate a software environment rapid construction facilities for robust software and intelligent systems technology prototypes. ($5.0M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology, PE 0602301E, Project ST-11

- Complete the experimental evaluated prototype implementations to support highly distributed, wide bandwidth information processing applications that require persistent objects. ($1.8M)
- Support software initiatives at the Software Institute, Johnstown. ($4.9M)

(U) **Program Change Summary:** *(In Millions)*   FY 1994   FY 1995   FY 1996   FY 1997

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	68.2	93.7	107.7	116.3
Current Budget	68.2	89.7	91.8	95.7

(U) **Change Summary Explanation:**

FY 1995 $2.7M reduction transferred to ST-23 to fund Seismic transition DOE.
           $1.3M reduction to fund TRP earmark.

FY 1996-97   Reflect offsets to satisfy DDR&E directed PDM offsets.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**   N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
High Performance Computing ST-19	191,928	246,200	243,547	250,757	255,260	257,503	289,034	303,484	Continuing	Continuing

(U) **Mission Description:** This project develops the computing, networking, and associated software technology base underlying the solutions to computational and information-intensive applications for future Defense and Federal needs. These technologies lead to successive generations of higher performance and more cost-effective systems scalable to a trillion operations per second (teraops) systems and billion bits per second (gigabits) networking, associated software technologies, advanced information infrastructure technology and prototype experimental applications leading to national-scale efforts across the Federal government. Results will be used in other ARPA and Defense programs for experimental application to critical defense problems.

(U) High Performance Computing (HPC) develops software and hardware technologies leading to a scalable computing and communications technology base for systems configured over a wide performance range, from mobile handheld devices to desktop workstations to the largest-scale, highest performance systems, including embedded versions of these systems.

(U) The Scalable Computing Systems component develops, demonstrates, and evaluates for early experimental use a variety of advanced scalable parallel systems at the frontier of computing, including embeddable HPC technologies for migrating commercial HPC systems into military embedded applications.

(U) The Microsystems component develops design tools, environments, and infrastructure to support the research and development of advanced scalable parallel computing components and systems for large-scale computing systems, embedded computing systems, and wireless computing systems. Microsystems also supports innovative system prototyping techniques in hardware and software as well as early small-scale architecture experiments leveraging scalable computing technology, micro-architectures, low-energy components and processes, optimization techniques, and advanced packaging technology.

(U) The Scalable Software component develops the operating systems and resource management technologies to effectively harness the computing power of high performance systems, as well as the compilers, tools, environments, and library technology that enable their effective use.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology, PE 0602301E, Project ST-19	September 1994

(U) The Information Infrastructure Software and Services component develops underlying technologies to support large, complex and distributed applications; building on privacy and trust mechanisms, remote resource sharing and information security capabilities developed in other components.

(U) The Information Infrastructure Applications Demonstrations component develops early prototype experiments of important large-scale, distributed applications in conjunction with various Defense and Federal programs.

(U) The Networking component develops high performance networking technologies and associated capabilities.

(U) The Information Security component develops technologies to prevent unauthorized entrance to systems, to protect the network infrastructure and information in transit, and to provide a range of basic security service including additional data security controls within applications. The Network Integrated Computing component focuses on emerging research and development that exploits the new opportunities at the intersection of high performance networking and high performance computing. The Defense Technology Integration and Infrastructure component applies the new scalable computing technologies to solve specific defense problems in innovative ways.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:
- Scalable Computing Systems. ($48.1M)
  - Developed foundations for petaoperations (1015) per second and terabits (1012) systems.
  - Demonstrated first multicomputer system containing multiprocessor nodes.
  - Developed 10 gigaflops/cu.ft. militarized, embeddable scalable computing system.
- Microsystems. ($34.8M)
  - Developed and demonstrated semiconductor virtual process design coupled to actual fabrication line for real-time process control.
  - Enhanced and demonstrated direct support of rapid prototyping of MCM technology.
  - Fabricated operational submicron diameter vertical Field Effect Transistor (FET) for ultra high density read-only memory.
  - Demonstrated 200 Mhz superpipelined processor as part of continuing architectural exploration of high performance system.
  - Developed and demonstrated tools and environments to support the design of low power and wireless computing systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19	

- Demonstrated enhanced fabrication services integrated with library management tools and extended system synthesis capabilities.

- Scalable Software. ($28.2M)
  - Demonstrated scalable libraries for defense-critical problems, such as computational physics and image processing.
  - Developed and distributed HPC software, documentation, performance measurements, and prototype applications using a wide-area file system.
  - Demonstrated distributed ADA on scalable HPC systems.
  - Prototyped HPC programming environments for standard languages like C++ and Fortran, while developing new languages like dataflow, advanced functional languages, and advanced object-oriented languages.
  - Demonstrated microkernel operating systems with performance comparable to integrated operating system, with new mechanisms for better scalability, real-time support, and extensibility.
  - Demonstrated early prototype of advanced secure operating system concepts such as domain/type enforcement, controlled execution, and security audits.

- Information Infrastructure Software and Services. ($10.1M)
  - Extended Privacy Enhanced Mail (PEM) to include abilities for multimedia attachments, multiple encryption methods, and alternative digital signature algorithms.
  - Developed prototype suite of advanced data storage and access tools, such as distributed and replicated file systems supporting intermittent communications, trusted and secure operations, more sophisticated access semantics, and multilevel storage management.

- Information Infrastructure Applications Demonstrations. ($3.9M)
  - Demonstrated initial national-level digital library for exchange of technical reports between five major universities, ARPA, and the Library of Congress.
  - Initiated, in conjunction with NSF and NASA, a broader initiative to expand digital library technology in the areas of information indexing, remote access, and storage management.

- Networking. ($40.1M)
  - Demonstrated C^3 systems technology with scalable high performance network technology enabling full multimedia real-time information exchange using early gigabit networks.
  - Demonstrated prototypes of gigabit SONET/ATM technology operating over fiber and satellite media.
  - Conducted demonstration of all-optical Local Area Networks (LANs).
  - Demonstrated medical, terrain visualization, and modeling applications on 100 Mbit and GBit-class networks.
  - In-laboratory demonstration of 30 gigabit per second wave division multiplexing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology, PE 0602301E, Project ST-19	September 1994

- Defense Applications and Infrastructure. ($26.7M)
  - Developed initial prototype of C³ and weapons systems using embeddable high performance technologies for Navy application.
  - Developed initial experimental capabilities employing advanced high performance computing technologies for Defense users.
  - Demonstrated networked technologies and capabilities for education, training, and human resource development pilot projects.

(U) FY 1995 Program:
- Scalable Computing Systems. ($57.6M)
  - Design teraops-class modules covering major models of scalable computing, spanning shared and distributed memory models and fine and coarse grain parallelism, as the foundation for next-generation and cost-effective units in computing systems.
  - Demonstrate 10 gigaflop/cu.ft. militarized HPC system.
  - First release of distributed real-time operating system for embeddable HPC.
  - Demonstrated software and hardware compatibility between scalable commercial HPC systems and embeddable versions.

- Microsystems. ($45.7M)
  - Extend network-accessible design and fabrication services to include computational prototyping concepts.
  - Develop early module-level synthesis capabilities.
  - Demonstrate wireless computing design environments through the design of early prototype, high bandwidth, pico cellular, and wireless access points to the wireline infrastructure.
  - Design flexible hardware accelerated protocol components.
  - Early computational prototyping demonstration of deriving electrical parameters from 3-D process models.
  - Initial demonstration of micro-architectures for advanced packaging and scalable units of replication.

- Scalable Software. ($29.5M)
  - Demonstrate real-time operating system support tools for scalable, distributed HPC systems.
  - Demonstrate software development environments for distributed heterogeneous systems on workstation-based tenth-scale teraops systems.
  - Experimentally characterize input/output requirements for large- and small-scale computing systems on scalable parallel systems.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Demonstrate prototype integrated HPC programming environment for Fortran and C++; demonstrate that significant user applications running transparently on several distinct scalable computer architectures without change.
- Develop portable, real-time fault tolerant operating system software which is compatible with embeddable and commercial scalable HPC systems.

• Information Infrastructure Software and Services. ($23.7M)

- Develop unified underlying storage mechanisms for network service directories, distributed file systems, and object-oriented database systems. Demonstrate their ability to support the input/output performance and storage capacity needs of advanced, distributed applications.
- Develop prototype accounting and usage metering service.
- Prototype generalized software applications approaches for discovering and interacting with services in a complex internetworked environment.
- Develop applications building blocks for application function partitioning and migration.
- Develop initial transparent relocation of computing and location-transparent access to data within mobile computing environment.

• Information Infrastructure Applications Demonstrations. ($10.0M)

- Select and experimentally characterize focused National Challenge applications testbeds leveraged on high performance network testbeds and major information technologies in high performance computing.
- Prototype technologies for distributed digital libraries, incorporating techniques for scalable storage management and data repositories, persistent object bases, and multimedia objects.
- Proof of concept prototype of copyright management system, based on Privacy Enhanced Mail (PEM), which demonstrates fully-electronic copyright registration, recordation, rights transfer and management.

• Networking. ($39.3M)

- Deploy small-scale, nationwide gigabit per second class infrastructure in support of high performance computing applications.
- Demonstrate cross-country gigabit and networking technologies.
- Demonstrate more advanced network capabilities, including multicast based services and next generation internet protocols, with embedded intelligence to improve the ease of use.
- Demonstrate techniques for rate-adaptive quality of service negotiation in asymmetric networks.
- Demonstrate bandwidth and service reservation guarantees for networks in support of real-time and critical services.
- Demonstrate robust multigigabit-per-second ATM switch with open signaling interface.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE:
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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Information Security. ($11.6M)
  - Demonstrate authenticated routing.
  - Complete Privacy Enhanced Mail and MIME (Multimedia Interoperable Mail Extensions) integration.
  - Demonstrate a scalable multipeer key management system.
  - Demonstrate a prototype system for intermittent connectivity secure file access.
  - Develop a common authentication and authorization service infrastructure based on digital signatures, public key cryptosystems, and privacy enhanced mail.
- Defense Applications and Infrastructure. ($28.8M)
  - Develop initial prototype of advanced C³ and weapons systems using advanced embeddable and high performance computing technologies.
  - Demonstrate integrated experimental capabilities employing advanced HPC technologies for Defense users.
  - Prototype networked and high performance computing capabilities for education, training, and human resource development projects.

(U) FY 1996 Program:

- Scalable Computing Systems. ($47.9M)
  - Demonstrate small-scale teraops class systems and individual gigaops processors. Systems are to include a prototype of fully scalable operating system software and programming environments.
  - Demonstrate closely coupled workstation-MPP interoperability.
  - Demonstrate first embeddable fine-grained scalable HPC System.
  - Prototype embedded computing system modules with scalability concepts containing memory hierarchy and power on a single unit of replication.
  - System-level demonstration of flexible programmable hardware protocol accelerators.
- Microsystems. ($38.9M)
  - Demonstrate initial network-based computational prototyping services.
  - Demonstrate integrated module-level synthesis capability.
  - Demonstrate design environments supporting simulation and synthesis of wireless systems spanning from integrated circuits to network applications.
  - Demonstration of fault tolerant and reliability design tools supporting large-scale HPC systems developments.
  - Demonstrate programmable high performance microsystem protocol processor.
- Scalable Software. ($23.0M)
  - Demonstrate integrated HPC programming environment for Fortran and C++.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology, PE 0602301E, Project ST-19	September 1994

- Develop second-generation of scalable, portable libraries.
- Demonstrate extensible modular operating system framework supporting real-time, distribution, and limited fault tolerance for a range of computing applications spanning from desktops to largest scalable heterogeneous systems.
- Demonstrate user extensible microkernel operating system technology, integrating compiler and run-time support services.

• Information Infrastructure Software and Services.   ($41.9M)

- Demonstrate prototype toolkits for adaptive application development.
- Develop file and operating system services supporting wide area collaborative work.
- Demonstrate location-transparent computing relocation and data access within a mobile computing environment.
- Initial prototypes of untethered node architecture for mobile computing.
- Enhance and experimentally evaluate advanced software environment that supports composition tools for composing softwares, integration, and software development and testing using animation techniques.
- Demonstrate initial capabilities for intelligent information services for resource description, registration and retrieval.

• Information Infrastructure Applications Demonstrations.   ($12.3M)

- Demonstrate first-generation experiments based on selected modest-scale National Challenge application testbeds.
- Develop a prototype for information and services as a "proof of concept" testbed for advanced electronic commerce and digital libraries, including experimental charging mechanisms.
- Develop mechanisms for higher service layer exploitation of privacy-enhanced electronic mail.
- Transfer electronic copyright management system to Library of Congress.

• Networking.   ($21.1M)

- Prototype networks at 10-100 Gbit speed using optical technologies and verify scalable network protocols.
- Demonstrate secured nomadic computing architecture integrated into existing wide area networks.
- Deploy reference implementation of protocol-independent multicast-capable infrastructure as basis for development of advanced services.
- Demonstrate robust network-level infrastructure protocols to include directory services and resource allocation.
- Demonstrate technology for autonomous management by delegation.

• Information Security.   ($20.6M)

- Deploy reference implementation of authenticated routing suitable for more widespread use.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Deploy reference implementation of authenticated network management.
- Deploy reference implementation of signed and authenticated directory services.
- Release first version of system security evaluation tools.

• Network Integrated Computing. ($11.4M)

- Develop a scalable, heterogeneous computing prototype based on proxy and distributed network computing services as a first step towards distributed metacomputing.
- Prototype latency tolerant communications in wide-area networks. ($26.4M)

• Defense Applications and Infrastructure.

- Demonstrate advanced Defense-specific functionality by incorporating real-time voice, video, and simultaneous processing of information intensive computing.
- Provide experimental testbed services employing advanced high performance computing technologies for Defense users.

(U) FY 1997 Program:

• Scalable Computing Systems. ($46.0M)

- Demonstrate scalable modules for teraop performance incorporating next generation technology.
- Demonstrate scalable embeddable HPC based on heterogeneous nodes.
- Demonstrate enhanced feature, real-time distributed operating systems for embeddable HPC.
- Demonstrate single machine image across physically-distributed individual nodes.

• Microsystems. ($37.1M)

- Demonstration of network-enabled services for system design and implementation, coupling computational prototyping with remote experimentation capabilities.
- Demonstrate microprocessor architectures augmented with multiprocessing features.
- Demonstrate high performance computing backplane components for local area networking.

• Scalable Software. ($19.5M)

- Demonstrate advanced programming languages (i.e., functional programming) as a viable environment for developing operating systems and other system software.
- Demonstrate optimizing compilers with 5-to-10 times code improvement through partial compilation and late optimization during program execution.
- Demonstrate advanced object management systems integrated with operating systems and applications to achieve efficient use of memory while enhancing execution speed.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Computing Systems and
BA 2 Exploratory Development	Communications Technology,
	PE 0602301E, Project ST-19

- Information Infrastructure Software and Services. ($43.0M)
  - Demonstrate advanced resource registration and discovery services available to applications, providing a common programming and user interface across diverse servers and protocols.
  - Demonstrate rapid adaptation to new service providers, such as publishers and repositories.
  - Demonstrate adaptive environment software toolkit for more rapidly developing complex, distributed applications.
  - Demonstrate bandwidth-aware computing relocation in a mobile environment.
  - Demonstrate robust mobile networking based on packet radio algorithms.
  - Demonstrate end-to-end application relocation within mobile environment.
  - Develop bandwidth-adaptive multimedia node for mobile computing.
  - Demonstrate feasibility of utilizing advanced software environment that supports composition tools for composing software, integration, and software development and testing using animation techniques in military environment.
  - Extend capabilities of intelligent information services architecture to provide resource providers with multiple mechanisms for describing resource capabilities and to provide resource seekers with a uniform interface to hybrid search methods for resource retrieval; demonstrate in multiple applications.

- Information Infrastructure Applications Demonstrations. ($16.2M)
  - Demonstrate fee-for-service testbed for U.S. financial system.
  - Demonstrate digital library and fee-for-service infrastructures applied to computational prototyping demonstrations.
  - Demonstrate an integrated infrastructure for active catalogs, rights management, and usage fees.

- Networking. ($22.8M)
  - Deploy reference implementation of a common base set of network infrastructure protocols and services necessary for secure and reliable network operation.
  - Demonstrate wide-area 10-100 Gigabit electro-optical transmission and switching systems.
  - Develop advanced multicast-based services to include refinements of collaboration systems and autonomous network processes.

- Information Security. ($21.8M)
  - Deploy reference implementation of enhanced firewall tools as preliminary Enclave offering.
  - Integrate monitoring/detection capabilities into firewalls and network management.
  - Deploy initial prototypes of secure hardware.
  - Develop enhanced CERT (Computer Emergency Response Team) capabilities.
  - Demonstrate privacy-enhanced remote database access.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-19

- Network Integrated Computing. ($20.8M)
  - Transition to national-scale experiments among interoperable sites.
  - Demonstrate remote access to data at near-local access performance.
  - Initiate integration of National Information Infrastructure Applications and Services within the unified Network-Integrated Resource.
- Defense Applications and Infrastructure. ($23.6M)
  - Full-scale deployment of testbed services for secure, computationally-intensive application of interest to DoD users.
  - Demonstrate use of collaborative networked-based infrastructure and high performance computing capabilities for advanced education, training, and human resource development projects.

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	192.2	243.7	234.5	266.3
Current Budget	191.9	246.2	243.5	250.7

(U) **Change Summary Explanation:**

FY 1994   Minor repricing.
FY 1995   Increase reflects funding of TRP earmark for networking.
FY 1996-97

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**   Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology, PE 0602301E

COST *(In Thousands)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Software Engineering Technology ST-22	37,415	40,223	19,562	19,205	18,678	20,250	23,250	25,136	Continuing	Continuing

(U)   **Mission Description:**   Software technology is a DoD key technology because of increasing demands for quality software in DoD software-intensive systems, and the need for an advanced state of software engineering practice in their production. This project funds the Software Engineering Institute (SEI) and the Software Technology for Adaptable, Reliable Systems (STARS) program to address the Department's software shortfalls. SEI and STARS efforts are aimed at enabling future DoD software intensive weapon systems to meet mission requirements quickly and affordably.

(U)   The SEI is a Federally Funded Research and Development Center, established in 1984, that conducts programs in software engineering. The SEI is composed of world class software engineers whose efforts are directed at transitioning technology and enhancing acceptance of modern software engineering techniques and methods, promulgating their use throughout the defense industry, and establishing standards of excellence for the software engineering profession.

(U)   The STARS program is a technology development, integration and transition program to demonstrate a process driven, domain specific, reuse-based approach to software engineering that is supported by appropriate tool and environment technologies. STARS is generating three key integrating elements toward a family of large-scale "software factory" products: a set of Software Engineering Environments (SEEs); a set of modern adaptable software life-cycle process building blocks; and a software asset library capability to facilitate software productivity. The SEEs will be composed of commercially-supported products with open interfaces to stimulate the Computer Aided Software Engineering tools marketplace. The SEEs will reinforce use of modern process models, have seamless interfaces to asset libraries, and will be evaluated on current DoD programs. FY 1995 is the last year of STARS program funding.

(U)   Program Accomplishments and Plans:

(U)   FY 1994 Accomplishments:

- Participated with and supported Services in STARS demonstration projects.   ($7.0M)
- Refine STARS concepts, processes, methods, and tools based on demonstration projects results.   ($5.5M)

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	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology, PE 0602301E, Project ST-22

(U)

- Continued the development and integration efforts in process and reuse technology. ($2.7M)
- Operated and enhanced ASSET capabilities. ($3.8M)
- Refined technology transition strategies; continue support for the Technology Transition affiliates program; continue commercialization initiatives; and refine and extend software development plan 2000. ($2.0M)
- Produced updated Software Process Assessment and Software Capability Evaluation instruments. ($4.5M)
- Documented architecture studies in Guidebook for Real-Time Air Vehicle simulators. ($4.5M)
- Developed/conducted Risk Identification Training Course. ($4.0M)
- Initiated development of a "Technology Maturity Model" and "Human Resources Maturity Model". ($3.4M)

(U) FY 1995 Program:

- Continue support to Services in STARS demonstration projects. ($6.0M)
- Test and evaluate software architectures and application code developed using STARS Technologies on demo projects. ($5.4M)
- Finalize STARS concepts, processes, methods, tools based on demonstration projects results. ($4.0M)
- Refine technology transition strategies, continue support for the Technology Transition affiliates program; continue commercialization initiatives; and software development plan 2000 available for wide-spread use. ($3.8M)
- Operate and enhance ASSET capabilities. ($2.0M)
- Develop initial version of "Process Value Method" for determining anticipated business value of a process change. ($2.0M)
- Develop Risk Evaluation training course. ($2.0M)
- Produce guides to best model-based software engineering practice ($6.0M); to best reengineering practice ($5.0M); and an Open Systems Architecture Handbook. ($4.0M)

(U) FY 1996 Program:

- Develop Capability Maturity Model (CMM) version 2. ($4.0M)
- Initiate CMM Validation and tailoring of CMM for small organizations. ($3.6M)
- Prepare Software Risk Capability Improvement Guide. ($3.0M)
- Develop Guide to Best Practice in system understanding. ($5.0M)
- Develop Open Systems Standard for High Performance Networks. ($4.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-22

(U) FY 1997 Program:
- Complete the systems engineering capability maturity model and validate with NCOSE. ($.8M)
- Produce assessment training for government and industry acquisition processes. ($3.1M)
- Initiate software risk management standards in acquisition practices. ($3.4M)
- Provide reference models and methods for evaluation of software architectures. ($3.3M)
- Produce comprehensive network security risk assessment technique and improvement approach. ($2.8M)
- Produce a Measurement Handbook for software. ($2.7M)
- Provide an engineering framework for reengineering and continuous evolution of systems. ($3.1M)

(U) **Program Change Summary:**   *(In Millions)*   FY 1994   FY 1995   FY 1996   FY 1997

President's Budget   37.5   40.2   19.6   19.2

Current Budget   37.4   40.2   19.6   19.2

(U) **Change Summary Explanation:**

FY 1994 Reduction reflects minor reprogramming.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**   N/A

UNCLASS:IED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE
September 1994

| APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development | | | | | | | | R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology PE 0602301E | | |

COST *(In Thousands)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Counterproliferation Technology ST-23 *	22,276	43,459	16,693	5,060	0	0	0	0	0	N/A

*The funding for the Counterproliferation portion of this project has been transferred to OSD PE 0605160D in FY 1996-2001.

(U) **Mission Description:** This program addresses the problem of counterproliferation, which has been highlighted by the DoD and will transfer to OSD in FY 1996, and a national effort for a Comprehensive Test Ban (CTB) Verification Readiness Program, which includes enhancing U.S. surveillance capabilities for monitoring worldwide nuclear explosions and developing technologies for detecting the production, testing and storage of nuclear materials and weapons.

(U)   The objectives of the counterproliferation effort are to develop new technologies and concepts and to leverage existing technology to support early detection, monitoring, and interdiction of the proliferation of nuclear, chemical, biological, and advanced conventional weapons. The program will develop and provide early demonstration of advanced sensors, information and intelligence processing, modeling, command and control, and response option technologies to enable the warning, capabilities assessment and tailored counterproliferation options that are required to effectively detect, monitor and neutralize these threats. This effort is critically needed to provide decision-makers with vastly increased flexibility in dealing with potential adversaries acquiring weapons of mass destruction (WMD). The FY 1995 program is focused on leveraging existing programs and extending them to counter weapons of mass destruction and related delivery systems in: remote and local sensors; data mining, fusion and decision support; target nomination and battle management; tracking and tagging; and scenario based modeling and simulation. Technology base efforts such as microelectronic mechanical systems, low power sources, wireless communications, networking, computing and information infrastructure are providing enabling technologies for many of the preceding applications. In parallel with that, rigorous analysis is being done to identify operational requirements and shortfalls to which specific advanced, high-risk technologies can be addressed. These activities support DoD-identified needs for: real time detection and characterization of BW/CW agents, including stand-off capability; passive defense capabilities in BW/CW environments; detection and tracking of shipments and control and accountability for WMD-related materials; the enhanced collection and analysis of intelligence; and underground structure detection, characterization, and hard target defeat.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology PE 0602301E, Project ST-23

(U)   The objective of the CTBT Verification Readiness effort is to support the legislative and Administration policy of completing negotiations of an internationally verifiable CTBT by 1996 with a demonstration of a prototype international verification system in 1995.   This project provides the advanced research and development of verification technologies that will be needed to negotiate and implement this treaty.   Included in this project is the development and testing of key elements of an International Monitoring System and advanced surveillance technologies needed for incorporation into existing operational nuclear monitoring systems.   The proliferation of weapons of mass destruction (WMD) and their associated delivery systems constitute the major threat to U.S. armed forces and allies in the Post-Cold War security environment.   This project also addresses methods for demonstrating technologies to enhance the monitoring of the Nuclear Non-Proliferation Treaty and its renewal.

(U)   **Program Accomplishments and Plans**:

(U)   FY 1994 Accomplishments:
        Counterproliferation (CP) Program.   ($10.4M)

        --   Analyzed requirements across the counterproliferation spectrum, surveyed previous and on-going efforts, and defined the WMD environment.

        --   Evaluated technologies for potential CP application which leverage ARPA work in detection and surveillance; information/intelligence exploitation; targeting and battle management; tagging and tracking; and modeling and simulation.

        --   Continued development of technologies for detection of trace evidence of nuclear weapon development, including improved laboratory nanoscale particle analysis techniques.

        --   Continued development of nuclear radiation detection and imaging sensors, including high-resolution, room temperature sensors.

        --   Began joint non-proliferation technology projects with scientific and engineering groups in the former Soviet Union.

        --   Developed components for and deployed operational prototype of a global proliferation monitoring system.
        U.S. CTB Verification Readiness Program.   ($11.9M)

        --   Developed and tested components of a prototype surveillance system which will be required for CTB monitoring, with focus on advanced signal processing technologies at a data center.

        --   Began implementation of technologies for global nuclear threshold monitoring.

        --   Developed and tested techniques for automated knowledge acquisition in areas where the U.S. had little previous experience.

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RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology PE 0602301E, Project ST-23

-- Explored technologies for automated signal processing, including machine learning and new visualization methodologies.

-- Transferred seismic sensor development technologies to operational agencies.

(U) FY 1995 Program:

Counterproliferation Program. ($25.1M)

-- Design and develop technologies for countering biological weapons (BW) proliferation, including fiber-optic, microelectromechanical, and other advanced biosensors; BW-specific process modeling; BW production vulnerability and tracking models; and a BW defense regime based on BW vaccines, immunomodulation, genetic targeting, structure based drug design, and therapeutics.

-- Design and develop technologies for countering chemical weapons (CW) proliferation, including reusable, miniaturized, multi-agent, high-sensitivity hand-held, underwater, and other advanced chemical agent sensors; CW-specific process modeling; CW production vulnerability and tracking models; and a CW defense regime based on agent detection, risk assessment modeling, and passive protection.

-- Design and develop sensors and characterization technologies for monitoring and for providing warnings and indicators of WMD activities, including internetted unattended ground sensors, tracking and surveillance fusion, high resolution room temperature radiation sensors, automated detection and recognition capabilities, and intelligence and objects database generation and correlation.

-- Design and develop information technologies for an interactive CP toolkit, including scenario modeling, distributive collaborative planning, text/speech/image fusion, and response option assessment tools; enhancement and application of generic monitoring and imagery exploitation technology to WMD-specific requirements; and information processing of open source and intelligence data to perform correlations based on WMD process and critical path models.

-- Continuation of ongoing, contracted efforts for development of prototype and laboratory systems for nuclear monitoring and sensor technologies and prototype monitoring stations, including nanoscale particle analysis techniques and neutron and gamma-ray detectors, coordinated with the other agencies.

-- Support ongoing technology efforts and potential Advanced Concept Technology Demonstration (ACTD) participation for characterization and signature collection of underground WMD facilities, including seismo-acoustic signal processing and environmental enhancement and low-frequency synthetic aperture radar.

-- Continue Congressionally-mandated cooperative programs with scientists and engineers from the former Soviet Union to develop sensor and other technologies for countering chemical and nuclear weapons proliferation.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide	Computing Systems and Communications Technology	September 1994
BA 2 Exploratory Development	PE 0602301E, Project ST-23	

-- Extend an existing test and evaluation facility to demonstrate, integrate, and evaluate technology impacts; to generate enabling technology such as common threats, scenarios, signatures, and databases, or interoperability and plug and play capabilities for sensors, software, communications, and simulations; and to aid in new starts selection process.

-- Continue to identify technology gaps for potential new starts via integrated methodology composed of expert panels (substantive and technical mix); modeling for candidate technology identification; quantitative impact assessment metrics; and rating schemes. Specify, define, and correlate sensor, processing, C3I and response option requirements and relevant technology state-of-the-art to identify technology gaps. Coordinate with DoD/DoE R&D plan and multi-year technological priorities and goals.

U.S. CTB Verification Readiness Program. ($18.4M)

-- Develop and test technologies for applying advanced signal processing technologies to large volumes of data from diverse multisensors required for CTB monitoring.

-- Develop methods of automated signal detection and characterization, especially for small seismic events.

-- Develop advanced computing system architectures and data management techniques for reliable and distributed processing.

-- Continue the transfer of advanced signal processing technologies into operational systems.

-- Develop and incorporate methods for non-seismic technologies into overall event detection and analysis.

-- Begin demonstration of capabilities of global CTB seismic monitoring system.

(U) FY 1996 Program:

U.S. CTB Verification Readiness Program. ($16.7M)

-- Demonstrate and evaluate with large databases advanced signal processing technologies, including data from various sensors required for realistic CTB monitoring.

-- Demonstrate automated methods for signal detection, analytical techniques for event characterization and distributed processing.

-- Prototype non-seismic methods for nuclear event detection and characterization incorporating methods to merge information from various technologies.

-- Demonstrate prototype capabilities for global CTB signal processing and analysis and continue transfer of demonstrated technologies to operational systems.

-- Prototype automated noble gas separator field unit for CTB treaty monitoring purposes.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Computing Systems and Communications Technology PE 0602301E, Project ST-23

DATE
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(U) **FY 1997 Program:**

. U.S. CTB Verification Readiness Program. ($5.1M)

-- Complete development and testing of methods for signal analysis and information fusion from CTB sensors.
-- Complete demonstration of prototype CTB signal processing system.
-- Complete technology transfer to United States Atomic Energy Detection Systems (USAEDS) and international CTB verification system.
-- Support required system enhancements required by USAEDS and international system.

(U) <u>**Program Change Summary:**</u>

	<u>FY 1994</u>	<u>FY 1995</u>	<u>FY 1996</u>	<u>FY 1997</u>
President's Budget	22.3	40.8	51.2	60.7
Current Budget	22.3	43.5	16.7	5.1

(U) <u>**Change Summary Explanation:**</u>

FY 1995 Increase to fund transition of seismic efforts to DOE.
FY 1996-97 Adjustments reflect transfer of Counterproliferation Program to OSD PE 0605160D.

(U) <u>**Other Program Funding Summary Cost:**</u> N/A

(U) <u>**Schedule Profile:**</u> N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE
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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Tactical Technology,
PE 0602702E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Tactical Technology	**90,053**	**111,343**	**112,874**	**113,109**	**135,074**	**145,879**	**157,620**	**189,386**	**Continuing**	**Continuing**
Naval Warfare Technology TT-03	26,421	33,383	44,969	56,241	70,410	58,687	59,407	70,173	Continuing	Continuing
Advanced Land Systems Technology TT-04	15,244	33,239	34,302	26,125	30,136	50,000	54,686	66,686	Continuing	Continuing
Advanced Targeting Technology TT-05	8,518	5,848	0	0	0	0	0	0	0	N/A
Advanced Tactical Technology TT-06	27,212	*38,873	33,603	30,743	34,528	37,192	43,527	52,527	Continuing	Continuing
Aeronautics Technology TT-07	12,658	0	0	0	0	0	0	0	0	N/A

*TT-07 consolidated with TT-06 in FY 1995-01.

(U) **Mission Description:** This program element is budgeted in the Exploratory Development Budget Activity because it supports the advancement of concepts and technologies to enhance the next generation of tactical systems. The FY 1996 Tactical Technology program funds a number of projects in the areas of Naval Warfare, Advanced Land Systems and Advanced Tactical technologies.

(U) The Naval Warfare Technology project is focusing on three areas: command, control, communications, and intelligence (C³I)/synthetic environments; ship system automation; and simulation based design. The C³I/synthetic environment program will create a multi-user maritime network to provide a planning and simulation capability that will improve training, readiness, and operations planning. The Ship Systems Automation program is developing a highly integrated sensor, weapons control, and battle damage suite to reduce costly shipboard manning requirements. Finally, the Simulation Based Design program will provide the tools required to integrate cost, performance, and manufacturing considerations throughout the design process.

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Tactical Technology,
PE 0602702E

(U) The Advanced Land Systems Technology project includes the Small Low-cost Interceptor Device (SLID) and the Operations Other Than War (OOTW) programs. The SLID program will develop and test a system for providing protection against missiles and projectiles with explosive warheads. The OOTW program focuses on technological solutions to critical problems of encountered in peacekeeping and non-combatant evacuation operations.

(U) Finally, the Advanced Tactical Technology project is exploring the application of compact lasers, microwave radiation and advanced mathematical algorithms to enhance the performance of radars, sensors, communications, and electronic warfare systems. The technologies under development will improve infrared countermeasures, enable active infrared suppression, permit faster signal processing, improve target recognition, and create smaller, more capable microwave devices.

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COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Naval Warfare Technology TT-03	26,421	33,383	44,969	56,241	69,487	58,687	59,407	70,173	Continuing	Continuing

(U) **Mission Description:** The Naval Warfare Technology project develops advanced technologies for application to a broad range of naval requirements. The enabling technologies include: Advanced design processes based on virtual prototyping and advanced modeling; Command, Control, Communications, and Intelligence/Synthetic Environments (C3I/SE) for littoral warfare including Transportation; and Integrated ship sensor, weapons and platform technologies to demonstrate the feasibility of automation for reduced ship manning.

(U) The Simulation Based Design (SBD) area is developing and demonstrating a prototype system that will enable a revolutionary change in the acquisition process for large, complex systems. SBD will enable establishment of a National Industrial Base, providing true dual-use development capability. The objective of SBD is to integrate the technologies of distributed interactive simulation, physics-based modeling, and virtual environments and apply them to the design, acquisition, and life cycle support processes of complex systems. SBD will utilize virtual prototypes in synthetic environments to enable effective, integrated product and process development. Complete simulation from early in concept formulation through verification of requirements to design, manufacture, operation, training, and logistics will be available prior to initiation of construction. This will permit realistic assessments of a candidate design throughout its lifetime. The system will provide significant cost savings through the reduction of: the number of expensive physical mockups, the total time for product acquisition, and the manufacturing inefficiencies caused by inadequate design.

(U) In the Command, Control, Communications, and Intelligence/Synthetic Environments (C3I/SE) area, advanced information and communications technologies are being developed in support of the situational assessment, planning, and mobile communications functions inherent in Commander in Chief (CINC) Command Centers, major CONUS support commands ashore, and mobile and theater Joint Task Force (JTF) Command Centers. The demonstration systems incorporate embedded internetted simulation capability for collaborative planning, evaluation, and rehearsal of all phases of operations including transportation with Commander Joint Task Force (CJTF) mobile and fixed units. It also uses the Maritime Synthetic Theater of War (MSTOW) for improving acquisition processes, training, readiness, and operations planning and rehearsal of the maritime component of U.S. forces. It builds upon existing ARPA-developed planning tools such as the Capability Assessment and Evaluation System (CASES), the Acoustic Warfare Integration Laboratory (AWIL), and the Maritime Anchor Desk, while identifying and incorporating other emerging C3I and information system technologies.

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RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology, PE 0602301E, Project TT-03

(U)   In the Ship Systems Automation (SSA) area, advanced, highly automated sensor, weapons control, and platform systems (including damage control) are being developed and demonstrated for submarine and surface ship applications. Through evolving sequential demonstrations of the technologies and their interactions, efforts in this area will show how an integrated system could achieve a significant reduction in crew size. Because personnel account for about 25% of ship life cycle costs, such a reduction would lead to immediate and long term cost savings for ship acquisition programs. SSA technology developments include intelligent command-level decision support components, scalable sensor integration work stations to fuse multi-source data and intelligently display the tactical situation on a tactical situation assessment system, cooperating expert systems conducting mission-context/sensor employment planning, and integrated internal condition sensor and control systems to intelligently display and control ship physical conditions on a ship's internal assessment system.

(U)   **Program Accomplishments and Plans:**

(U)   FY 1994 Accomplishments:

- Conducted the final Simulation Based Design (SBD) feasibility demonstration showing real-time interaction in a virtual environment, seamlessly integrating component production from design through manufacture; initiated the development of key enabling technologies. ($8.4M)

- Initiated development of process models to enable agile manufacturing in shipyards. ($0.9M)

- Demonstrated a full fidelity acoustic synthetic ocean environment simulation capability and commenced development of a synthetic electromagnetic environment. ($3.2M)

- Initiated development of an integrated situation assessment, planning, and planning assessment architecture and associated wideband communications antenna technologies for Commander in Chief (CINC) and mobile Commander Joint Task Force (CJTF) command complexes. Demonstrated connectivity and initial assessment capabilities. ($5.9M)

- Developed the architecture for Ships Systems Automation (SSA) in the four major operator/associate areas of Tactical Scene, Tactical Action, Platform Readiness, and Command & Control; conducted initial laboratory demonstration of the Tactical Scene Operator/Associate area. ($3.0M)

- Pursued new and follow-on efforts for the Center of Excellence for Research in Ocean Sciences (CEROS) ocean science efforts. This effort was funded by a Congressional addition to the FY 1994 President's Budget. ($5.0M)

(U)   FY 1995 Program:

- Initiate SBD prototype development and conduct initial demonstration using the facilities of a regional design center. ($7.0M)

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RDT&E, Defensewide	Tactical Technology,
BA 2 Exploratory Development	PE 0602301E, Project TT-03

- Conduct interim demonstrations of SBD critical enabling technologies.   ($7.7M)
- Conduct demonstrations of agile manufacturing concepts for shipyards.   ($1.1M)
- Demonstrate an initial integrated Command, Control, Communication, and Intelligence/Synthetic Environment (C3I/SE) architecture in a selected maritime theater-wide planning/planning assessment scenario at a Commander in Chief (CINC) Command Complex and linked at-sea Commander Joint Task Force (CJTF). Conduct laboratory demonstration of advanced technology wideband satellite communications between the CINC and mobile CJTF command complexes.   ($7.0M)
- Expand synthetic environment development to include a complete electromagnetic environment creating a full spectrum Maritime Synthetic Theater of War (MSTOW).   ($2.3M)
- Conduct Ship Systems Automation (SSA) demonstrations with emphasis on Tactical Scene Assessment/Presentation and Defensive Warfare Associate, interactive component technologies, and force multiplier technologies that support significantly reduced manning on warships.   ($8.3M)

(U) FY 1996 Program:

- Conduct interim Simulation Based Design (SBD) prototype demonstrations on a complex application at a design center, using virtual prototyping technologies.   ($8.0M)
- Conduct interim demonstrations of SBD enabling critical technologies.   ($7.5M)
- Demonstrate full spectrum MSTOW in an advanced demonstration.   ($1.7M)
- Demonstrate C3I/SE collaborative planning at the afloat numbered fleet commander and below.   ($5.1M)
- Conduct land-based Navy laboratory simulation/stimulation demonstration of SSA interactive component technologies.   ($6.8M)
- Demonstrate advanced SSA algorithm and integration verification in coordination with Navy and university laboratories.   ($4.1M)
- Investigate and begin development of sonar system based on biological sonar architectures.   ($0.5M)
- Initiate development of a full fidelity transportation synthetic environment that will permit distributed visualization and interaction with all phases, elements and components of the military/commercial transportation infrastructure to support policy, planning, acquisition and real time operations and replanning.   ($11.3M)

(U) FY 1997 Program:

- Conduct interim SBD prototype demonstrations on a complex application using advanced virtual prototyping technologies.   ($8.5M)
- Conduct interim demonstrations of SBD enabling critical technologies.   ($7.1M)
- Complete development of and demonstrate C3I/SE maritime mission planner.   ($4.2M)

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RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology, PE 0602301E, Project TT-03

- Demonstrate at sea a two-band, multi-mode satellite antenna with functional linkage to a grid ashore. ($2.0M)
- Demonstrate a synthetic electromagnetic environment for ship defense systems. ($2.1M)
- Conduct an integrated, fully-reactive land-based demonstration of all Ship Systems Automation (SSA) Operator/Associate pairs in the Combat Information Center (CIC) of the future facility. ($10.7M)
- Demonstrate distributed transportation simulation in support of military transportation planning/replanning for a major regional contingency. ($12.0M)
- Demonstrate distributed transportation simulation to support a natural disaster requiring emergency rerouting of goods and supplies for disaster relief. ($9.6M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	26.5	33.4	36.7	37.7
Current Budget	26.4	33.4	45.0	56.2

(U) **Change Summary Explanation:**

FY 1994   Reduction of $0.1 million reflects minor repricing.

FY 1996-97 Increases reflect allocation of additional funds to emphasize and demonstrate distributed transportation simulations for both military and civilian regional contingencies.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:** N/A

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Tactical Technology
PE 0602702E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Land Systems Technology TT-04	15,244	33,239	34,302	26,125	30,136	50,000	54,686	66,686	Continuing	Continuing

(U) **Mission Description:** This project is intended to develop technologies for contingency missions and military Operations-Other-Than-War to make U.S. combat forces more deployable, effective, survivable, and affordable. This project supports three main efforts: Operations-Other-Than-War (OOTW); Battle Management Architecture, Data-Base Modeling and Technology Development; and Small Low-cost Interceptor Device (SLID).

(U) Military Operations-Other-Than-War (OOTW) is the aspect of military operations that focuses on deterring war, resolving conflicts and promoting peace. Example activities are peacekeeping, counterterrorism, demining, noncombatant evacuation operation and support to insurgency. Military OOTW missions share many common needs and characteristics with Law Enforcement (LE) missions and share a similar vision: protecting the lives of friendly forces as they perform their mission; minimizing collateral damage to noncombatants; and operating in a multicultural/multinational/multilingual environment. Technologies will be developed to provide both civil and military usage.

(U) ARPA will focus on solutions that will improve our ability to conduct OOTW missions through affordable, advanced technologies. Technology developments are being conducted in personal extremities armor, non-lethal weapons, sensor surveillance through wall and covered enclosures, concealed weapon detection, non-English speech interpretation/translation, miniature geo-location, navigation and data transfer subsystems, countermine/demining, and anti-mortar/anti-sniper sensors. Those technologies that minimize response time to achieve mission goals will be emphasized. Working with the potential user, the OOTW program will exploit ARPA simulation technologies to help define technology requirements. Memorandums of Understanding are in place, or under negotiation, with the Department of Justice and U.S. Special Operations Command.

(U) The Battle Management Architecture, Data-Base Modeling and Technology Development program addresses command and control problems of highly mobile, joint contingency forces. On-the-move units currently cannot obtain a joint common picture of the battlefield or any graphics or imagery, and have limited planning tools available. The goal of

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BA 2 Exploratory Development	PE 0602702E, Project TT-04

this effort is to determine commander's information needs and to develop technologies to allow synchronized Battle Management and to improve the situational awareness and response option generation of highly mobile joint contingency forces commanders at all levels. This project will provide the information, interface and interconnect technology base for the Command and Control Information Systems project in PE 0603226E, project EE-21. The information processing display and communications capabilities will be exercised and tested in a Battle Management Architecture Evaluation Model. The Battle Management project is related to advanced architecture and data-base modeling in project EE-37 which serves as one test and evaluation mechanism.

(U)   The Small Low-cost Interceptor Device (SLID) program will develop and test a system for providing protection against missiles and projectiles with explosive warheads. This system will detect, track, and intercept these threats at a standoff distance sufficient to render them ineffective. Applications for the SLID system include self-defense of vehicles, high value fixed sites such as command centers, aircraft hangars, radars, and perhaps aircraft.

(U)   **Program Accomplishments and Plans:**

(U)   FY 1994 Accomplishments:

- Modified and enhanced Common Targeting System and Advanced Deep Operations Coordination System and integrated into Korea's Theater Automated Command and Control Information Management System. ($2.0M)
- Continued exploration of commercial communications leveraging opportunities and conducted brassboard test of applicability to dismounted/mounted operations. ($4.0M)
- Integrated helicopter detection and classification algorithms into the Army's wide area mine (WAM). Transitioned to Army. ($1.5M)
- Terminated Turbo-Roto-Compound engine and transitioned technology to industry. ($1.0M)
- Began risk-reduction phase of the Small Low-cost Intercept Device (SLID) program. ($2.1M)
- Developed and demonstrated selected simulation-based design tools required to simultaneously address performance and producibility of new weapons concepts. Defined concept for integrated system of design workstations. Transitioned program to PE 0603226E, project EE-37. ($2.7M)
- Acquired exhaust and projectile acoustic and infrared signatures from mortars and sniper rifles against various background clutter situations. ($.1M)
- Identified and assessed potential means of providing extremities protection using advanced ARPA ceramic and other composite materials. ($.2M)
- Identified and assessed currently available demining systems and established plan for demining a test range. ($.3M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology PE 0602702E, Project TT-04

- Identified and assessed potential sensors for performing countermine operations, wall penetration and weapon detection. ($.2M)
- Assessed potential technologies for geolocating/data transfer devices. ($.2M)
- Initiated OOTW requirements and technology assessment. ($.7M)
- Initiated operations research and systems analysis for demining operations. ($.2M)

(U) FY 1995 Program:

- Initiate development of information processing, interface and interconnect technology to support Command and Control Information System in EE-21 and have evaluation conducted by Battle Management Evaluation environment funded within EE-37. ($4.9M)
- Continue Phase I (risk reduction) efforts in the SLID program and perform downselection for Phase II. ($8.6M)
- Identify and assess potential means of performing mortar and sniper localization using acquired signature data. ($.9M)
- Initiate demining BAA for new technology and conduct first demining trials of existing systems. ($9.8M)
- Develop techniques and a testbed for advanced computerized speech processing and translation. ($.3M)
- Develop advanced extremities protection technologies. ($1.0M)
- Develop and test advanced countermine, wall penetrating and weapon detection sensor concepts. ($2.3M)
- Develop advanced geolocating/data transfer technologies with near term demonstrations to user community. ($3.0M)
- Continue OOTW Simulation and Assessment studies with users to confirm technology meets Service needs. ($.4M)
- Initiate development of Anti-Mortar/Anti-Sniper Detection System. ($2.0M)

(U) FY 1996 Program:

- Complete development of information processing, interface and interconnect technology to support Command and Control Information System in EE-21. Transition technology. ($6.9M)
- Initiate SLID phase II effort with remaining contractors. Perform sub-system tests leading to static system tests. ($9.6M)
- Continue to develop technologies for anti-mortar and anti-sniper operations. ($2.1M)
- Continue to develop techniques and the testbed for advanced computerized speech processing and translation. ($1.1M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology PE 0602702E, Project TT-04	September 1994

- Continue to develop and test advanced countermine, wall penetrating and weapon detection sensor concepts. ($4.8M)
- Continue to develop advanced extremities protection technologies. ($3.0M)
- Continue to develop advanced geolocating/data transfer technologies. ($5.5M)
- Continue OOTW Simulation and Assessment studies with users to confirm technology meets Service needs. ($1.3M)

(U) FY 1997 Program:

- Continue SLID phase II effort. Conduct full system static tests and tests against slowly moving targets. Prepare for live-on-live tests. ($12.5M)
- Continue to develop technologies for anti-mortar and anti-sniper operations. ($2.4M)
- Continue to develop techniques and the testbed for advanced computerized speech processing and translation. ($2.5M)
- Continue to develop advanced extremities protection technologies. ($2.0M)
- Continue to develop and test advanced countermine, wall penetrating and weapon detection sensor concepts. ($2.9M)
- Continue to develop advanced geolocating/data transfer technologies. ($3.8M)

(U) **Program Change Summary:**   (In Millions)   FY 1994   FY 1995   FY 1996   FY 1997

President's Budget   14.9   33.2   32.7   31.5

Current Budget   15.2   33.2   34.3   26.1

(U) **Change Summary Explanation:**

FY 1994/96 Relects minor repricing.
FY 1997   Reduction reflects the completion of Information Processing and Interface Technology development.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**   N/A

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Tactical Technology,
BA 2 Exploratory Development	PE 0602702E

COST *(In Millions)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Targeting Technology TT-05	8,518	5,848	0	0	0	0	0	0	0	N/A

(U) **Mission Description:** By integrating advanced algorithms (automatic target recognizers) and processing technologies with multiple imaging sensors, autonomous intelligent submunitions will enhance U.S. force projection by providing a flexible and accurate delivery of munitions on a wide range of targets. Damocles will demonstrate a lower cost, intelligent, and effective submunition against these targets. It will have the ability to cover a large footprint (greater than 1 sq.km.) once deployed from a carrier vehicle and automatically search for, detect, and recognize sparsely positioned targets, such as SCUDS, SS-21s, and their support vehicles.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:
  . Completed Damocles hardware and software integration into test fixture. ($1.0M)
  . Performed captive carry tests to collect data and test hardware and software integration. ($6.0M)
  . Performed initial free flight experiments. ($1.5M)

(U) FY 1995 Program:
  . Complete Damocles experiments, tests, and analysis. ($5.8M)

(U) **Program Change Summary:** *(In Millions)* <u>FY 1994</u> <u>FY 1995</u> <u>FY 1996</u> <u>FY 1997</u>

President's Budget	8.3	5.8	0	0
Current Budget	8.5	5.8	0	0

(U) **Change Summary Explanation:**

(U) FY 1994   Increase reflects minor repricing.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:** N/A

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology, PE 0602702E

COST *(In Thousands)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Tactical Technology TT-06	27,212	38,873	33,603	30,743	34,528	37,192	43,527	52,527	Continuing	Continuing

(U) **Mission Description:** This project focuses on the technology and applications of compact lasers, microwave radiation sources, and mathematical algorithms for signal processing to dramatically improve the performance of radars, sensors, and systems for electronic warfare and communications. Seven broad technology areas are being investigated: (a) compact, efficient, frequency-agile, diode-pumped, solid-state lasers for infrared countermeasure, laser radars and sensors; (b) compact high density data storage for high bandwidth image processing; (c) high performance, pulsed radio frequency (RF) radiation sources for smaller and better microwave tubes; (d) fast computational algorithms for signal processing, target recognition, electro-magnetic and acoustic propagation in nonlinear medium; and (e) passive infrared signature suppression to counter the predominate air-to-air missile threats; (f) precision optics components and systems for critical DoD applications; and (g) "Hybrid Reality" optical displays which synthesize on- and off-board sensor information driven by fast computational algorithms with machine intelligence. In addition, as an enabler of electronic warfare decoy concepts, the SENGAP propulsion system will be flight tested to validate the successful ground bench tests and integration with a decoy air vehicle.

(U) **Program Accomplishments and Plans:**

(U) **FY 1994 Accomplishments:**

- Compact Laser ($5.9M): Performed technology demonstration of power laser operation at one micron; semiconductor diodes for laser pumping; and active target acquisition for infrared countermeasure and laser radars.
  - Demonstrated one kilowatt average power one micrometer wavelength laser with output at 10 joule/100 Hertz (Hz), 10 nanosecond pulse length.
  - Demonstrated new semiconductor laser diodes operating at 808 nanometer wavelength.
  - Demonstrated wavefront aberration corrections for active pointing and tracking.
  - Demonstrated design concepts for high repetition rate infrared countermeasure laser.
- Holographic Data Storage ($2.5M): Demonstrated new hologram fixing and multiplexing techniques for holographic data storage system.
- Pulsed Radio Frequency (RF) ($10.1M): Designed and fabricated advanced RF radiation sources for radar and RF countermeasure.
  - Designed and fabricated electronic system to demonstrate cooperative angle jamming technique.

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RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology, PE 0602702E, Project TT-06

- Designed and fabricated 44 gigahertz (GHz) solid state, high efficiency amplifiers for space applications.
- Designed microwave power tube using microcathode to operate at 10 GHz.
- Demonstrated high performance 94 GHz amplifier operation and began prototype design.
- Designed, fabricated and demonstrated ultra high resolution radar operation using electromagnetic shockline technology.

• Fast Computational Algorithms ($8.7M): Began to develop novel algorithms for automatic detection and recognition of difficult-to-find objects.
  - Developed wavelet-based multi-resolution methods and design tools for new digital filters.
  - Demonstrated wavelet methods for detection of transient signals in sonar systems and for multisensor fusion.
  - Demonstrated robust methods for direction finding and interference reduction in airborne platforms.
  - Developed code for fast computation of electromagnetic scattering.

(U) FY 1995 Program:

• Compact Lasers ($5.0M): Demonstrate breadboard systems of compact high power lasers at one micron, tunable mid-infrared lasers, aluminum free laser diodes and active tracking systems at mid infrared wavelengths.
  - Demonstrate transportable brassboard one kilowatt average power one micrometer wavelength laser with output at 10 Joule/100 Hertz (Hz), 10 nanosecond pulse length.
  - Demonstrate laser diode bar arrays at continuous wave and quasi-continuous wave output at 808 nanometers.
  - Demonstrate laboratory breadboard tunable mid-infrared lasers for U.S. Army advanced technology infrared countermeasure program.
  - Demonstrate and test a laboratory breadboard active tracking system for mid-infrared wavelengths.

• Holographic Data Storage ($6.9M): Technology demonstration of page-format, high density input and readout capability.
  - Demonstrate prototypes of test charge coupled devices, spatial light modulators and experimental validation of concept for holographic recording through waveguides.

• Pulsed Radio Frequency (RF) ($7.6M): Continue fabrication and integration of advanced RF amplifiers and power combining techniques.
  - Fabricate triode amplifier using microcathode operating at 10 gigahertz (GHz).
  - Design and fabricate prototype high performance 94 GHz power amplifier.
  - Demonstrate high efficiency power combining technique of solid state devices operating at 44 GHz.
  - Design reconfigurable antenna using microtip and diode laser technology.
  - Field test cooperative angle jamming technique and high resolution radar.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	**R-1 ITEM NOMENCLATURE** Tactical Technology, PE 0602702E, Project TT-06

- Fast Computational Algorithms ($12.7M): Continue development of novel algorithms for automatic target detection, materials and microelectronics processing.
  - Develop and test novel wavelet-based algorithms and tools for digital processor and filters.
  - Develop methods for multiresolution synthetic aperture radar and adaptive waveform design.
  - Apply wavelet design tools to tactical communications and target recognition.
  - Demonstrate fast multipole radar cross section code for an order-of-magnitude increase in capability.
  - Develop simulation tools, signal processing and modern control methods for in-situ sensing and real-time control of materials and microelectronics processing.
  - Develop optimal phase-shift mask design methods.

- Miniature SENGAP turbine engine ($3.9M): Flight test miniature SENGAP engine to validate successful bench testing and integration with decoy air vehicle concept.

- Advanced Infrared Signature Suppression ($2.7M): Complete Phase 2 of longwave infrared (LWIR) program.

(U) **FY 1996 Program:**

- Compact Lasers ($7.0M): Demonstrate compact lasers and active tracking systems at mid-infrared wavelengths for IR countermeasures.
  - Demonstrate mid-infrared lasers, packaged for slow motion, dynamic testing.
  - Demonstrate and test compact active tracking system brassboard for mid-infrared wavelengths.

- Holographic Data Storage ($6.0M): Technology demonstration to establish system trade-offs of various candidate materials for holographic data storage.
  - Demonstrate proof-of-principle holographic data storage devices to establish the capability of various multiplexing methods and error detection and correction schemes.

- Pulsed Radio Frequency (RF) ($3.3M): Continue fabrication and demonstration of advanced RF amplifiers and power combining techniques.
  - Demonstrate low voltage operation of microtriode amplifier operating at high frequency.
  - Demonstrate high efficiency power combining technique of solid state amplifiers.

- Fast Computational Algorithms ($5.6M): Complete development of novel algorithms for automatic target detection and recognition; validate and begin transition.
  - Demonstrate wavelet-based methods for data compression and clutter/noise removal.
  - Demonstrate wavelet-based methods for automatic target detection and recognition.
  - Demonstrate multiresolution methods and adaptive waveforms for image formation and processing.

- Advanced Infrared Signature Suppression ($4.8M): Flight test of long-wave infrared (LWIR) suppression system. Initiate development of advanced infrared (IR) suppression technologies for advanced aircraft.

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RDT&E, Defensewide BA 2 Exploratory Development	Tactical Technology, PE 0602702E, Project TT-06	September 1994

- "Hybrid Reality" Optical Displays ($6.9M): Develop fast, high fidelity panoramic display medium; develop and demonstrate real time sensor fusion algorithms and integrate with optical display format.

(U) FY 1997 Program:

- Compact Lasers ($7.2M): Demonstrate breadboard systems of compact high power tunable mid-infrared lasers, and laser diodes operating at mid-infrared wavelengths.
  - Demonstrate laboratory breadboard tunable mid-infrared lasers at 10 watt output with 10 Kilohertz (KHz) pulse repetition rate for large aircraft infrared countermeasures.
  - Demonstrate mid-infrared laser diodes.
- Holographic Data Storage ($5.0M): Technology demonstration to establish functional limits of holographic data storage.
  - Demonstrate holographic data storage testbeds for functional evaluation of write once read many (WORM) storage systems.
- Fast Computational Algorithms ($4.1M): Transition novel algorithms for automatic target detection and recognition to selected applications.
  - Complete final algorithm selection and validation for system insertion.
- Advanced Infrared Signature Suppression ($4.7M): Continue development of advanced IR suppression technologies for advanced aircraft.
- "Hybrid Reality" Optical Displays ($9.7M): Demonstrate multiple sensor data representations on display in real time; demonstrate capability to provide synthesized sensor data prioritization in visual medium.

(U) **Program Change Summary:** (In Millions)

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	26.3	38.9	27.1	36.1
Current Budget	27.2	38.9	33.6	30.7

(U) **Change Summary Explanation:**

FY 1996   Adjustments reflect an investment in "Hybrid Reality" optical display technology.
FY 1997   Funding transferred to MPT-06 for cryogenic technology efforts.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:** N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

		DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Integrated Command and Control Technology, PE 0602708E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
High Definition Systems IC-03	84,490	67,950	68,000	68,000	68,000	68,000	68,000	68,000	Continuing	Continuing

(U) **Mission Description:** This program element is budgeted in the Exploratory Development Budget Activity because it develops the technology and manufacturing capability for high definition displays and is important for virtually all DoD applications that involve visual and graphic information. Major components of this program include: projection, head mounted and direct view displays based on multiple technologies; display architectures and processors; compression algorithms; and high speed data transmission. These efforts will establish a domestic technical capability and demonstrate the manufacturing capability of components necessary for military systems that capture, process, store, distribute and display high resolution images.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Continued development of flat panel and projection displays for aircraft cockpit, shipboard and mobile computing and communications applications. ($19.6M)
- Continued development of enabling technology critical to high projection display performance. ($13.4M)
- Developed imaging systems and processes needed to realize high information throughput. ($6.5M)
- Completed active matrix liquid crystal display (AMLCD) Pilot Demonstration Facility. ($25.0M)
- Initiated second AMLCD manufacturing testbed facility. ($20.0M)

(U) FY 1995 Program:

- Continue development of flat panel and projection displays for aircraft cockpit applications, mobile computing displays, and shipboard and landbased command and control centers. ($28.0M)
- Continue enabling material and component technologies for performance and cost goals for liquid crystal materials, polymer electroluminescent materials, lightweight optics, polarizers, color filters, flat backlights, projection lamps, field emitter materials and structures, and phosphors. ($8.0M)
- Develop manufacturing equipment and processes for the affordable production of high definition displays. Flat panel display manufacturing equipment will be scaled up to handle larger substrates at higher throughputs with improved process capability. ($7.0M)
- Design and fabricate radio-based communication modules and components. ($8.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE
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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Integrated Command and Control Technology, PE 0602708E, Project IC-03

(U)

- Develop displays with integrated computation and image processing. ($4.0M)
- Develop U.S. display industry infrastructure and help foster new domestic display business by reducing business risk and dependence on foreign suppliers. ($8.0M)
- Develop improved phosphor materials and deposition processes for emissive displays (electroluminescent, field emission and plasma displays), and train people in phosphor technology. ($5.0M)

(U) FY 1996 Program:

- Continue development of flat panel and projection displays for aircraft cockpit applications, mobile computing displays, and shipboard and landbased command and control centers. ($30.0M)
- Continue development of enabling material and component technologies including liquid crystal materials, electroluminescent materials, phosphors, laser illumination sources, projection screens, projection lamps, thin film transistors and color filters to meet display cost and performance goals. ($7.0M)
- Continue development of manufacturing equipment and processes for the affordable production of high definition displays. Printing processes and equipment will be developed to deposit and pattern photoresist, metals, insulators and semiconductors over large areas in a single step. ($8.0M)
- Continue development of U.S. display manufacturing supplier infrastructure. ($13.0M)
- Develop technologies that will increase display system functionality while constraining cost by integrating microprocessors, memory, sensors and new features into displays. ($4.0M)
- Continue developing imaging systems technology to realize high information throughput display systems. ($6.0M)

(U) FY 1997 Program:

- Continue development of flat panel and projection displays for aircraft cockpit applications, mobile computing displays, and shipboard and landbased command and control centers. ($26.0M)
- Continue development of enabling material and component technologies including liquid crystal materials, electroluminescent materials, phosphors, laser illumination sources, projection screens, projection lamps, thin film transistors and color filters to meet display cost and performance goals. ($6.0M)
- Continue development of manufacturing equipment and processes for the affordable productions of high definition displays. Printing processes and equipment will be developed to deposit and pattern photoresist, metals, insulators and semiconductors over large areas in a single step. ($10.0M)
- Continue development of U.S. display manufacturing supplier infrastructure. ($11.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

		DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Integrated Command and Control Technology, PE 0602708E, Project IC-03

- Develop technologies that will increase display system functionality while constraining cost by integrating microprocessors, memory, sensors and new features into displays. ($7.0M)
- Continue developing imaging systems technology to realize high information throughput display systems. ($8.0M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	84.8	68.0	68.0	68.0
Current Budget	84.5	68.0	68.0	68.0

(U) **Change Summary Explanation:**

FY 1995   Reduction due to minor below threshold reprogramming.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**   N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE
September 1994

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Materials and Electronics Technology,
PE 0602712E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Materials and Electronics Technology	261,174	223,756	243,145	249,511	286,905	280,946	336,319	389,712	Continuing	Continuing
Materials Processing Technology MPT-01	129,054	100,700	114,828	122,067	136,387	135,349	148,094	185,240	Continuing	Continuing
Electronic Processing Technology MPT-02	94,332	94,323	83,821	85,710	99,291	100,214	136,179	155,972	Continuing	Continuing
High Temperature Super-conductivity (HTSC) MPT-06	37,788	13,438	11,996	12,274	13,240	5,183	7,546	0	0	N/A
Military Medical/Trauma Care Technology MPT-07	0	15,295	32,500	29,460	37,987	40,200	44,500	48,500	Continuing	Continuing

(U) **Mission Description:** This program element is budgeted in the Exploratory Development Budget Activity because its objective is to develop technology related to those materials, electronics, and medical devices that make possible a wide range of new military and commercial capabilities. Many of the programs contained in this Program Element reflect the Department's initiative to support dual-use technologies.

(U) The Materials Processing project (MPT-01) concentrates on the development of novel materials, processing techniques, and fabrication strategies for production of higher performance advanced structural and electronic materials manufactured at a lower cost. A major area of concentration is the application of process modeling, mathematical simulation, sensors, and advanced control to materials manufacturing, thin film processing, large area multichip module manufacture, and flexible fabrication and assembly. It includes research on composite materials, synthesis of diamond films; insertion of ceramics into military system components; flexible solid freeform manufacturing; toxic waste elimination; modeling and simulation of vapor phase processing of thin film materials; development of high power, high temperature semiconductors; and adaptive ("smart") materials and structures.

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	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Materials and Electronics Technology, PE 0602712E

(U)   The Electronics Processing project (MPT-02) develops advanced electronic and optoelectronic devices, semiconductor process tools and methodologies, and materials for infrared devices. Areas of emphasis include high-performance analog-to-digital converters, military optical processors, novel optoelectronic devices, artificial neural network technology, low power electronics and semiconductor process design and synthesis.

(U)   The High Temperature Superconductivity project (MPT-06) materials have reached a stage of development when specific applications have been identified in thin-film electronic devices and circuitry for military avionics with concomitant benefit to commercial electronics.

(U)   Military Medical/Trauma Care Technology project (MPT-07) is an initiative to significantly improve battlefield trauma care. The Advanced Biomedical Technology portion focuses on the human factors of advanced technology concepts in a front-line battlefield environment through development of body-worn monitors, field-portable digital imaging equipment, and battlefield surgical simulators. The Health Care Information segment concentrates on development of physician, medic, and community information associates for utilization by both medics during combat care scenarios and physicians during patient visits.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE September 1994

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Materials and Electronics Technology,
PE 0602712E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Materials Processing Technology MPT-01	129,054	100,700	114,828	122,067	136,387	135,349	148,094	185,240	Continuing	Continuing

(U) **Mission Description:** The major goals of this project are to develop novel affordable materials, processing techniques, and fabrication strategies for production of advanced structural, electronic and magnetic materials and components and devices with improved performance and at lower manufacturing costs. A major area of concentration is the application of process modeling, mathematical simulation, sensors, and advanced control to materials manufacturing, thin film processing, large area multichip module manufacture, and flexible fabrication and assembly. Other predominant areas include: biosensors for chemical and biological surveillance and digital imaging systems for battlefield trauma care; and research on composites (metal matrix, polymer matrix, ceramic matrix, carbon-carbon and microlaminate) for advanced aerospace structural materials to upgrade gas turbine engine and airframe components. Non-destructive evaluation (NDE) equipment and techniques will be developed for component evaluation and structural integrity monitoring.

(U) Additional areas of focus are: smart materials and structures, synthesis of diamond films for thermal management in electronic packaging; high temperature semiconductors, such as silicon carbide for high power applications in aircraft and electric vehicles; insertion of state-of-the-art ceramics into military system components (bearings, gas turbine engine components); precision machining of high strength alloys, composites and ceramics using laser and electron beam energy sources; and flexible energy delivery systems; and process diagnostic tools.

(U) Flexible solid freeform manufacturing capabilities are being developed for high performance structural materials (especially ceramics), which will fabricate functional components directly from Computer Aided Design (CAD) files and not require part-specific tooling or operator intervention. Research on magnetostrictive materials will enable demonstration of a non-volatile magnetic random access memory (RAM) with high density, short access time, infinite cycles, and low power. Physical optical research will develop affordable technology and computer aided manufacturing systems for the next generation of optical instruments. Environmental research includes DoD-related toxic waste elimination and "green" manufacturing, which seeks to eliminate or minimize toxic waste produced by manufacturing of products relevant to the DoD. Additionally, an effort will exploit recent advances in solid phase synthesis and computational chemistry to allow for the development of sequence-specific synthetic heteropolymers (SSSHP) with important functional capabilities.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE
September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Biotechnology ($7.9M): Utilized biological technologies to develop pharmaceuticals, sensors and imaging systems for battlefield trauma care.
  - Evaluated duration/magnitude of immune response to ultrasonically altered infectious organisms.
  - Initiated development of portable digital x-ray imaging system for battlefield trauma care.
  - Optimized fluidics subsystem, optimize dynamic range for cell-based biosensor.
  - Completed toxicity and efficacy studies in animal models systems (lyme disease demonstration application; completed cloning of parasitic antigens and initiated development of recombinant vaccine studies (lyme disease and malaria demonstration application).

- Structural Materials ($46.0M): Developed and demonstrated structural materials in affordable components, (composites, ceramics, alloys) for jet engines, airframes, missiles and other DoD systems.
  - Identified preliminary on-line sensing concepts for composite density enhancement during direct conversion of liquid hydrocarbon to pyrolytic carbon composite matrix during manufacturing; developed reaction chemistry for incorporation into computational process model.
  - Demonstrated feasibility for an order of magnitude increase efficiency of materials utilization during vapor deposition of titanium in the manufacture of silicon carbide reinforced titanium matrix composites using metal matrix composite model factory.
  - Initiated a program for manufacturing of silicon carbide fiber reinforced titanium alloys for components in aircraft gas turbine engines.

- Material and Device Manufacturing ($14.0M): Fabricated functional prototype components directly from Computer Aided Design (CAD) files. Reduced cost of final machining and assembly of composites and other structures. Developed processing technologies for manufacturing multi-chip modules.
  - Demonstrated solid freeform fabrication machine capability for producing particulate reinforced metal matrix composites with mechanical properties comparable to those manufactured by conventional methods.
  - Developed concepts of flexible manufacturing to actively correct machine error using adaptive materials.
  - Initiated a cross-disciplinary materials research program, which included research on electro-optics, catalysts for hazardous and toxic substance disposal, diamond film growth, and durable protective oxidation-resistant coatings for superalloys.
  - Developed concepts for flexible methods for laser shaping materials that undergo plastic flow.
  - Identified large format manufacturing materials and critical unit processes and initiated materials and equipment development for multi-chip module (MCM) manufacturing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Materials and Electronics Technology,
BA 2 Exploratory Development	PE 0602712E, Project MPT-01

- Advanced Materials and Processing ($18.8M): Reduced processing cost of advanced composites, electronic/photonic materials, and smart materials/structures. Incorporated simulation, modeling and intelligent processing of materials concepts.
  - Initiated program in high temperature, high power semiconductors for aircraft and electric vehicle engine control applications.
  - Initiated program to model and simulate vapor processing of materials and plasma etch manufacturing processes.
  - Initiated program to develop theoretical models for predicting mechanical properties of compositionally modulated multilayer structural composites.
  - Initiated program to develop intelligent processing production of materials for smart structures.
  - Initiated program to develop smart materials mechanics theories.

- Batteries ($6.4M): Improved energy density of military batteries.
  - Completed program for rapid prototyping of solid polymer electrolyte rechargeable ambient temperature batteries which provide power for a wide range of manportable military electronic equipment.

- Vapor Phase Processing ($17.5M): Developed low-cost processing of diamond films and photovoltaics for electronic applications.
  - Demonstrated on-line sensors and feedback control of chemical vapor deposition reactors; implemented second-generation control systems on direct current (DC) arc reactor systems; increased diamond manufacturing throughput with increased deposition rate, area and yield.
  - Demonstrated feasibility for low-cost, high-rate, high materials utilization efficiency manufacturing of copper-indium-diselenide multilayer photovoltaics using cylindrical magnetron sputtering.

- Environmental Science ($13.5M)
  - Initiated program to develop new casting technologies which reduce the emissions of foundries in anticipation of Clean Air Act standards for benzene, formaldehyde, and hydrocarbons. Focus is on emissions measurements, core and mold making technology, metal melting treatments and handling, sand reclamation, and emissions control.

- Coal Utilization ($5.0M)
  - Continued research for further reductions in gaseous and particulate emissions when firing coal-based fuels in industrial-scale boilers.
  - Developed coal-based fuel/waste co-firing technologies.
  - Identified and tested coal-based technologies that are suitable for small-scale heat and/or power applications.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Materials and Electronics Technology,
BA 2 Exploratory Development	PE 0602712E, Project MPT-01

(U) FY 1995 Program:

• Biotechnology ($1.9M): The basic research portion of this effort is found under PE 0601101E, Project MS-01. Complete program and transition to Advanced Biomedical Technology Program. PE 0601101E, project MS-01 and 0602712E, project MPT-07).

- Demonstrate gain of a biosensor device by modulation of intrinsic cellular amplification system (second messenger system).

• Structural Materials ($22.9M): Develop affordable composites using intelligent processing of materials and automated manufacturing concepts.

- Demonstrate on-line sensing of critical product and process variables and multivariable feedback control of the rapid densification manufacturing process for carbon-carbon composites.

- Develop advanced electron beam curing process suitable for on-line production of polymer matrix composites.

- Develop cost effective manufacturing process for silicon carbide fiber reinforced titanium for turbine engine components.

- Demonstrate reduced mean-time-between-failure (MTBF) associated with the upgrade of glass optical domes used in the Angle Rate Bombing Set (ARBS) of the AV-8B Harrier aircraft to spinal domes.

- Demonstrate the increased performance of the M1A2 tank dual-axis head mirror assembly by replacing nickel-coated beryllium metal with silicon carbide.

• Material and Device Manufacturing ($30.5M): Extend program to address hard and soft tooling, laser cutting and manufacturing capabilities and large format for multi-chip modules.

- Develop prototype design for adaptively-controlled machine tools, including a control scheme to correct machine errors.

- Characterize thermo-mechanical properties of laser shaped parts; develop real-time process controls for laser shaping.

- Develop and apply sensor technologies for on-line process control for the large-format and roll-to-roll unit manufacturing tools identified for development of multi-chip modules.

- Demonstrate performance of large format unique materials in the manufacture of multichip modules.

- Utilize selected laser sintering and 3-D printing solid free-form fabrication, demonstrate structural ceramic and metal components with strengths comparable to what can be produced using mass manufacturing methods.

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Exploratory Development

R-1 ITEM NOMENCLATURE
Materials and Electronics Technology,
PE 0602712E, Project MPT-01

- Advanced Materials and Processing ($24.8M): Continue processing developments for affordable materials.
  - Improve defect density in semiconducting silicon carbide boules to optimize electrical properties and increase yield.
  - Develop architecture for vapor phase simulation code along with process modeling and simulation kernels.
  - Develop computer models for plasma sprayed metal matrix composites.
  - Demonstrate manufacturability of smart materials.
  - Demonstrate feasibility of large area RF plasma diamond deposition.
  - Develop theoretical and computational methods to predict structural and electro-optic properties for semiconductor superlattices.

- Vapor Phase Manufacturing ($10.5M): Develop intelligent processing technologies to scale-up cost-effective manufacturing of thin film photovoltaics, multilayer turbine engine coatings, and thin film high temperature superconductor devices.
  - Demonstrate vapor deposition process models for physical and chemical vapor deposition.
  - Demonstrate on-line sensing to measure critical process and product parameters in the manufacture of thin film functional multilayer structures.
  - Initiate development of plasma modeling and simulation tools for vapor deposition technologies.
  - Demonstrate cost-effective manufacturing and pilot line scale-up of thin film photovoltaics.

- Environmental Sciences ($10.1M): Destroy DoD toxic waste using bioremediation and supercritical water oxidation (SCWO). Reduce toxic waste production as by-products of DoD-related manufacturing processes ("green" manufacturing).
  - Exploit SCWO technology and initiate construction of transportable SCWO system capable of processing 1,000 gallons per day.
  - Develop alternative electronic manufacturing processes for minimization/elimination of toxic wastes.
  - Conduct survey of casting emissions and install research foundry.
  - Development of site characterization requirements for risk assessment.
  - Site selection for prototype process design and demonstrations (bioremediation).

(U) FY 1996 Program:
- Structural Materials ($17.7M)
  - Demonstrate full-scale rapid densification of carbon-carbon composite components.
  - Demonstrate a five-fold improvement in the life of the roll reaction control (RRC) valve bearings on the AV-8B Harrier aircraft due to the upgrade of the metal bearings with ceramic hybrid bearings.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Materials and Electronics Technology,
BA 2 Exploratory Development	PE 0602712E, Project MPT-01

- Validate the Resonant Ultrasonic Inspection Nondestructive Evaluation (NDE) technique for ceramic rolling elements through beta site testing at a commercial ball bearing finisher.
- Establish quantitative criteria for NDE imaging for flaw detection.
- Complete detailed design of polymer composite integrated airframe component.
- Evaluate strength and stiffness of metal matrix composite (ceramic fiber reinforced titanium) hollow fan blade for jet engines.

- Material and Device Manufacturing ($46.2M)

- Demonstrate prototype multichip modules with laminate technology compatible with roll to roll manufacturing.
- Demonstrate the use of X-ray tomography and develop software to generate CAD files from solid objects compatible with requirements of solid freeform manufacturing.
- Develop the machine capability to produce silicon nitride components using the fused deposition method with silicon nitride powder loaded wax filaments.
- Demonstrate the capability to fabricate molds for slip casting structural ceramics using the 3-D printing technology.
- Demonstrate application of smart materials to reconfigurable machines and tooling hardware.
- Establish microgrinding and finishing techniques for reflective and refractive optical components.

- Advanced Materials and processing ($25.6M)

- Develop a Chemical Vapor Deposition (CVD) process for the fabrication of particulate and chopped fiber reinforced composites with 10X increase in composite growth rate over normal CVD processing; and demonstrate the utility of the fabricated composites for the die casting of copper alloys.
- Design, fabricate and evaluate fiber reinforced ceramic matrix composites fins for the Army's Line of Sight Anti-Tank (LOSAT) missile with a 50% weight savings over the current materials (steel).
- Develop magnetoresistive materials with improved electrical resistance properties.
- Develop simulation codes for vapor deposition processes and validate on industrial processes and reactors.
- Develop feedback control methods for plasma sprayed metal matrix composites.
- Demonstrate greater than 50 fold increase in CVD diamond deposition rate (from 60 mg/hr to greater than 3000 mg/hr) with a large area and high rate deposition system.
- Develop stable contacts for high temperature, high power semiconductors.
- Demonstrate material sensor and activator components manufacturability utilizing piezoelectric ceramics and electrostrictors.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	DATE September 1994
RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01

- Vapor Phase Processing ($11.6M)
  - Demonstrate automated pilot line manufacture of thin film photovoltaic panels.
  - Demonstrate an order of magnitude improvement in jet engine compressor blade erosion resistance through the use of multilayer coatings.
  - Demonstrate high yield large area processing of thin film high temperature superconducting devices.

- Environmental Sciences ($13.7M)
  - Design a supercritical water oxidation system for shipboard use in waste disposal.
  - Initiate risk assessment methodologies for bioremediation; develop baseline criteria and metrics for risk reduction.
  - Demonstrate more environmentally sound manufacturing processes for printed wiring boards.

(U) **FY 1997 Program**

- Biotechnology ($1.1M)
  - Initiate linkage chemistry to attach sequence specific heteropolymers "sponge" to fibers and resins.

- Structural Materials ($18.2M):
  - Demonstrate cost effective manufacturing of high performance friction carbon-carbon composites.
  - Demonstrate a 2X increase in mean time between failures (MTBF) associated with the replacement of carbon engine starter oil face seals on aircraft (C-5, A-10, KC135R, F-111, C-130 and C-141) with ceramic face seals.
  - Design, build and test a solid-state ceramic oxygen membrane generating system (COGS) for aircraft use.
  - Design prototype electron beam facility for curing polymer matrix composites.
  - Establish quantitative predictions of structural strength using NDE measurements.

- Materials and Device Manufacturing ($42.9M):
  - Demonstrate the capability to produce ceramic components with complex geometry and dimensional tolerances and mechanical properties comparable to mass manufactured advanced ceramics using the Jet Printer technology (3-D printing).
  - Develop a new solid freeform build method for ceramic components based on layer by layer photolithography utilizing either large area liquid crystal display, or a light emitting diode display technology for electronic/programmable photomasks.
  - Test reconfigurable machines and tools in shop floor beta test sites.
  - Demonstrate fabrication process for microintegrated smart materials.
  - Demonstrate roll-to-roll pilot line manufacture of laminate multichip modules.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 2 Exploratory Development	Materials and Electronics Technology, PE 0602712E, Project MPT-01	September 1994

- Demonstrate aspherics with back surface diffractive optics.
- Advanced Materials and Processing ($29.7M)
  - Determine the economic viability of Templated Grain Growth (TGG), a process by which solid phase epitaxy of crystallographically oriented seeds on near net shaped pollycrystalline components is used for growth of single crystal-like oxides.
  - Determine the performance characteristics of low cost, damage tolerant fibrous monolith components in engine environments.
  - Demonstrate control of plasma sprayed metal-matrix processing and extend process control models to physical vapor deposition of metal coated fibers.
  - Complete development of a plasma/ion etch numerical simulation.
  - Demonstrate predictive capability of high-pressure, low-order, chemical vapor deposition models and demonstrate feedback control to a desired wafer state.
  - Develop manufacturable processes for large area deposition of giant magnetoresistive materials and bipolar spin resistors.
  - Demonstrate intelligent manufacturing of large area chemical vapor deposition (CVD) diamond with a production cost of $1.00 per karat.
  - Grow single crystal boules for three inch diameter silicon carbide semiconductor wafers by scaling up the reactor and developing larger seed crystals.
  - Demonstrate vibration reduction by a factor of ten in machine tools via specially designed sensor/actuator elements to enhance machining tolerances.
- Vapor Phase Processing ($12.9M)
  - Demonstrate a 5X cost reduction in manufacture of thin film photovoltaic modules.
  - Demonstrate high yield multilayer coding of complex shape turbine engine components.
- Environmental Sciences ($17.2M)
  - Demonstrate a supercritical water oxidation pilot plant for the destruction of shipboard hazardous materials.
  - Complete design and testing of risk assessment tools for bioremediation of DoD hazardous waste sites.
  - Demonstrate novel recycling/reclamation techniques for disposal of scrap polymer matrix composites.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Materials and Electronics Technology, PE 0602712E, Project MPT-01

(U) <u>**Program Change Summary:**</u>   *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	129.1	106.8	112.1	125.2
Current Budget	129.1	100.7	114.8	122.1

(U) <u>**Change Summary Explanation:**</u>

FY 1995   Reduction of $6M reflects transfer of funds towards Congressionally-mandated Technology Reinvestment Program efforts.

FY 1996-97   Adjustments reflect enhancement of emphasis in the areas of Physical Optics, Magnetic Material, and Non-Destructive Evaluation, as well as transfer of funds for the enhancement of Cryogenic Technologies to project MPT-02.

(U) <u>**Other Program Funding Summary Cost:**</u>   N/A

(U) <u>**Schedule Profile:**</u>   N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

		DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Electronics Processing Technology MPT-02	94,332	94,323	83,821	85,710	99,291	100,214	136,179	155,972	Continuing	Continuing

(U) **Mission Description:** This element develops advanced electronic and optoelectronic devices, semiconductor process tools and methodologies, materials for optoelectronics and infrared devices. Areas of emphasis include high performance analog-to-digital converters (ADCs), military optical processors, novel optoelectronic devices and modules, artificial neural network technology and low power electronics. This microelectronics development project creates the technology base for advanced electronic and optoelectronic components to meet DoD needs. In this project the feasibility of promising research results are developed to the point where their military utility can be determined. Many of the tasks in this project culminate in a subsystem prototype insertion demonstration.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

. Tested first iteration GaAs hetero-junction bipolar transistor (HBT)-based ADCs for sampling speed and dynamic range. ($7.0M)

. Completed design and demonstration of GaAs HBT-based ADCs support components, such as multi-plexers and demultiplexers. ($4.0M)

. Initiated effort to develop a design system for circuits operating above 10 GHz. ($2.4M)

. Initiated development of neural network-based systems for signal processing applications (including signal demodulation, noise removal, face recognition, character recognition, large-vocabulary speech recognizers and multi-modal command systems for computer interfaces). ($4.0M)

. Developed neural network automatic target recognizer for future insertion into the Comanche Helicopter. ($.8M)

. Demonstrated electronic neural network hardware boards with speeds of up to 10 billion operations per second, and developed component technologies for optoelectronic systems that promise up to 10 trillion operations per second. ($3.0M)

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-02

- Completed studies on requirements and candidate hardware/software designs for an Advanced Vision System (AVIS) that will accelerate image processing and recognition algorithms. ($2.9M)
- Demonstrated optically controlled phased arrays and fiber-optic-based bi-static radar. ($2.7M)
- Demonstrated optical pattern recognition modules. ($2.2M)
- Demonstrated acousto-optic pulse compression signal processor and jammer nulling processor. ($2.5M)
- Demonstrated optical electronic warfare channelizer and precision direction finder. ($1.7M)
- Developed packaged optoelectronic-microwave modules for microwave transmission. ($1.0M)
- Developed integrated monolithic tunable laser arrays. ($2.7M)
- Initiated efforts to develop low-cost optoelectronic module manufacturing technologies. ($16.5M)
- Developed optoelectronic packages that incorporate passive alignment techniques between fibers and component input/output (I/O). ($4.5M)
- Established consortia for rapid automated optical alignment packaging and for accelerated development of blue lasers for insertion into laser memory disk systems. ($8.0M)
- Improved ferroelectric memory cell performance, especially imprint characteristics. ($1.4M)
- Initiated optical and electrical characterization of III-V bulk materials for optoelectronic and infrared device applications. ($2.5M)
- Initiated fabrication and evaluation of wide band gap II-VI blue emitters produced on III-V substrates. ($4.0M)
- Completed design of crystal growth system for 1kg InGaAs boule for 50mm diameter substrates. ($3.0M)
- Initiated program to optimize computer architecture and supporting design systems that fully exploit area array interconnects and multi-chip-module packaging. ($8.5M)
- Initiated program to demonstrate speed optimization with cryo-cooling. ($7.0M)
- Initiated a program to demonstrate a large format plasma processing of chemical vapor deposition (CVD) diamond. ($2.0M)

(U) FY 1995 Program:

- Validate high speed heterojunction bipolar transistor (HBT) technology by manufacturing components on pilot production lines. ($17.5M)
- Demonstrate the high-speed HBT process via components in a system application. ($2.3M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Materials and Electronics Technology,
BA 2 Exploratory Development	PE 0602712E, Project MPT-02

- Establish transitions for mature neural network signal processing systems (including signal demodulators and adaptive filters), and continue development of high-performance end-to-end systems (including speech recognizers, human computer interfaces, and image recognizers). ($4.3M)
- Comprehensively test neural network target recognizer in preparation of insertion into Comanche Helicopter. ($1.0M)
- Perfect electronic neural network boards and demonstrate on realistic applications; demonstrate optoelectronic hardware at 1 trillion operations per second. ($3.7M)
- Establish the Advanced Vision Systems (AVIS) architecture framework and design custom chips. ($4.6M)
- Establish AVIS software requirements and initiate software development (including custom compilers, languages, debuggers, case tools, libraries, and environments). ($2.9M)
- Develop key components for affordable optoelectronic modules. ($10.0M)
- Field demonstration of optical pattern recognition modules, optical real-time synthetic aperture radar processor and pulse compression signal processor. ($1.0M)
- Demonstrate advanced serial and parallel optoelectronic busses. ($6.7M)
- Initiate insertion of prototype optoelectronic modules into system applications. ($5.0M)
- Establish manufacturing infrastructure for optoelectronic modules. ($4.1 M)
- First pass design of process synthesis framework architecture. ($5.0M)
- Development of the process synthesis architecture database methodology. ($5.0M)
- Development of reliability prediction simulation. ($1.4M)
- Develop 3.3 volt silicon on insulator (SOI) technology. ($8.0M)
- Develop unit simulation CAD tools. ($2.8M)
- Initiate consortium in nanolithography, nanoelectronics, and high-speed supercomputer visualization. ($9.0M)

(U) FY 1996 Program:

- Deliver fully tested analog to digital converters, digital to analog converters, and multiplexers and demultiplexers. ($4.0M)
- Initiate prototype projects using heterojunction bipolar transistor components. ($6.5M)
- Establish transitions for high-performance neural network systems (including speech recognizers, human computer interfaces, and image recognizers). ($5.0M)
- Develop neural network sensor fusion techniques for automatic target recognition for future insertion into Comanche and other platforms. ($1.5M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Materials and Electronics Technology,
BA 2 Exploratory Development	PE 0602712E, Project MPT-02

- Establish transitions for electronic neural network hardware boards and demonstrate full-scale optoelectronic systems at 10 trillion operations per second. ($5.0M)
- Fabricate and test custom hardware for the Advanced Vision Systems (AVIS) program; develop packaging and integration strategies. ($5.6M)
- Develop first generation AVIS software (including custom compilers, languages, debuggers, case tools, libraries, and environments). ($6.0M)
- Develop critical subassemblies for digital optoelectronics processors. ($3.5M)
- Develop key components of an optical backplane. ($8.0M)
- Develop packaged affordable serial output (serial or parallel data in) optoelectronic modules. ($10.0M)
- Develop packaged cost effective parallel output (parallel in, parallel out) optoelectronic modules. ($10.0M)
- Initiate development of radio frequency photonic subsystems for microwave/millimeter transmission. ($3.7M)
- Develop 1.5 volt silicon on insulator (SOI) technology. ($10.0M)
- Develop circuit synthesis CAD tools. ($2.7M)
- Demonstrate self-clocking circuits. ($2.5M)

(U) FY 1997 Program:

- Develop integrated CAD tool set for high speed (>1GHz) designs. ($7.6M)
- Initiate demonstration of high speed analog to digital prototype. ($11.0M)
- Complete Advanced Vision Systems (AVIS) hardware modules. ($3.0M)
- Refine and complete AVIS software based on user feedback. ($4.0M)
- Demonstrate AVIS on image recognition application. ($.9M)
- Demonstrate optoelectronic processor breadboard. ($2.0M)
- Demonstrate neural network data fusion techniques in systems concept. ($8.0M)
- Demonstrate blue/green lasers with 25 hour lifetime. ($3.0M)
- Demonstrate packaged serial optoelectronic modules and identify dual use applications. ($8.0M)
- Demonstrate packaged affordable parallel output (parallel in, parallel out) optoelectronic modules. ($8.0M)
- Demonstrate optical backplane compatible with electronic packaging approaches. ($9.0M)
- Continue development of radio frequency (RF) photonic subsystems for microwave/millimetric wave transmission and develop millimetric wave-optical RF distribution antenna network. ($7.5M)
- Develop 0.9 volt silicon on insulator (SOI) technology. ($9.0M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Materials and Electronics Technology, PE 0602712E, Project MPT-02

- Complete development of multi-GHz simulation tools. ($2.0M)
- Field test low power subsystem. ($2.8M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	94.3	88.5	92.0	97.9
Current Budget	94.3	94.3	85.8	85.7

(U) **Change Summary Explanation:**

FY 1995   Increase of funds due to a Congressionally mandated TRP effort in nanoelectronics.
FY 1996-97 Adjustments reflect offsets to satisfy directed POM offsets.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:** N/A

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Materials and Electronics Technology, PE 0602712E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Toual Cost
High Temperature Superconductivity MPT-06	37,788	13,438	11,996	12,274	13,240	5,183	7,546	0	0	N/A

(U) **Mission Description:** High temperature superconducting (HTS) materials have reached a stage of development where specific applications can be identified in thin-film electronic devices and circuitry for military avionics, with concomitant benefit to commercial electronics. The ARPA program is building specific insertions for radar and electronic detection systems with extremely wide bandwidth and dynamic range, general avionics, and airframe guidance subsystems, while continuing with the development of the underlying fabrication technology for thin films, bulk wire and other forms. Particular demon trations include a switched filter bank for the B-1B radar warning receiver, superconducting electronic packages for electronic intelligence (ELINT) and electronic warfare suites in reconnaissance aircraft, and safe and economical devices for riveting and clamping sheet metal sections for aircraft manufacturing.

(U) Another objective of this project is to integrate those demonstrated technologies whose performance improves at low temperatures, with a cryocooler, in demonstration of a module with superior electronic performance. Such modules will find application in (1) wireless communications networks for cellular base station-nodes; (2) Cryocomputers, mid-range computers such as workstations; and (3) medical instrumentation, a magnetic resonance imaging microscope. Previously demonstrated technologies to be integrated include low-power microelectronics, HTS, multi-chip modules (MCMs) and magnetoresistive random access memories (RAM).

(U) **Program Accomplishments and Plans:**

(U) **FY 1994 Accomplishments:**

- High Temperature Superconductors/Analog and Digital Applications ($23.5M): Pursued insertions of HTS materials in thin-film analog and digital electronic devices and circuitry. Transferred the technology to applications such as computer-aided engineering (CAE) software tools for HTS circuit characterization and optimization, and integration of available cryogenic refrigerators with HTS devices.
 - Continued development of optically-switched 30-element HTS filter bank to enable signal discrimination in radar warning receivers (RWR) in a dense countermeasure environment.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 2 Exploratory Development	Materials and Electronics Technology, PE 0602712E, Project MPT-06

- Improved acoustical damping of stabilized oscillator (STALO) based upon high-Q high temperature superconducting (HTS)/sapphire resonant cavity, to achieve a factor of 100 improvement over current radar.

- Characterized performance criteria for radar receiver to detect sea-skimming missiles at adequate ranges in sea clutter, based upon HTS reference source and preselective filter bank integrated with low-noise antenna driver and appropriate closed-cycle cryogenic cooling system.

- Initiated development of an HTS crossbar switch to provide very high connectivity and performance enhancement (X5) over current capability, for application to mainframe computers and telecommunications.

- Demonstrated digital circuits such as an asynchronous transfer mode (ATM) switch for the DoD global grid network and/or the commercial information infrastructure.

- Incorporated HTS analog components in cellular telephone and personal communications networks, utilizing the high-power handling and discrimination capability of thin-film HTS tuned filterbanks, delay lines and other components to provide enhanced coverage with better unit isolation.

- Developed wide-bandwidth HTS antennas and high-efficiency HTS coupling networks for application as miniaturized radio frequency (RF) sensors and transmitters in electronic warfare scenarios.

- High Temperature Superconductors/Multi-Chip Modules (MCM) ($14.3M): Demonstrated a fully functional module utilizing approximately 50 complementary metal oxide semiconductor (CMOS) chips which will operate with x 2 greater speed in a more compact form.

- Extended materials processing capabilities to develop ion etching as a planarization technique for insulating dielectric layers and develop photoresist and etching procedures to attain fully reproducible 2 micron interconnect linewidth.

- Developed technology infrastructure by extending commercial computer-aided engineering (CAE) tools for normal metal interconnects to accommodate HTS interconnects, transitioning such capability to HTS vendors and MCM manufacturers.

- Developed alternate HTS MCM architectures such as the dual-offset mesh plane process.

- Integrated closed-cycle cryofrigerator with MCM module for a complete push-button system.

(U) FY 1995 Program:

- High Temperature Superconductors/Analog and Digital Applications ($13.4M): Identify the most promising HTS applications to achieve the planned culmination of the program: (1) filter banks for alleviating saturation of radio warning receivers (RWR), (2) high resolution radar receivers, (3) crossbar switches as computer components, and (4) analog components for communication networks.

- Extend the switched HTS filterbank to be fully compatible with the RWR requirements of several aircraft Electronic Warfare (EW) suites.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Materials and Electronics Technology,
BA 2 Exploratory Development	PE 0602712E, Project MPT-06

- Integrate the stabilized oscillator (STALO) with the low-noise antenna driver and preselective filter bank to verify that the noise floor meets performance requirements to detect sea-skimmers.

- Undertake Complimentary Metal Oxide Semiconductor (CMOS) optimization according to the design proven with gallium arsenide components in room temperature crossbar switch and characterize performance at low temperature with high temperature superconductor (HTS) interconnects.

- Demonstrate function of filter networks, delay lines and other components according to specifications in subscale versions of communication networks.

(U) **FY 1996 Program:**

- High Temperature Superconductors/Analog and Digital Applications ($4.0M): In this final year of the HTS Program, the focus will be on five insertion opportunities:

  - Provide fully-integrated 32-element filterbank with refrigerator to F-15 project office for aircraft demonstration. Provide 96 element filterbank to B-1B project office for utilization.

  - Complete evaluation of cryo-radar with HTS STALO and preselective filter bank, and determine performance specifications for low target cross-section detection.

  - Complete development of crossbar switch and cryo-workstation to insert cryo-optimized packaged semiconductor integrated circuits in computers.

  - Complete funding for Consortium for Superconducting Electronics, with demonstration of prototype cellular base station and Superconducting Quantum Interference Device (SQUID) array for magnetocardiography.

  - Demonstration of a high-performance 8x8 asynchronous transfer mode (ATM) cryogenic switch in a wide area network.

- Cryogenics Technologies. ($8.0M)

  - Undertake development of small/inexpensive reliable cryocoolers for application to communications, computers and medical instrumentation.

  - Develop sources for optimal electronic devices and components, such as CMOS, ICs and multichip modules (MCMs).

  - Initiate applications demonstrations, with integrated cryocoolers and temperature-optimized components.

(U) **FY 1997 Program:**

- Cryogenics Technologies ($12.3M)

  - Demonstrate integration of cryocooler with workstation module, consisting of advanced microprocessor, associated controller and cache memory, with enhanced performance.

  - Demonstrate assembled HTS filterbank and matching network components in simulated cellular base station.

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	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-06

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	37.8	14.2	4.0	0
Current Budget	37.8	13.4	12.0	12.3

(U) **Change Summary Explanation:**

FY 1995   Reduction reflects transfer of funds towards a congressionally mandated effort for the Technology Reinvestment Program.

FY 1996-97 Adjustments reflect enhancement of emphasis in Cryogenic Technologies.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:** N/A

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		DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Exploratory Development	R-1 ITEM NOMENCLATURE Materials & Electronics Technology, PE 0602712E

COST *(In Thousands)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Military Medical/Trauma Care Technology MPT-07	0	15,295	32,500	29,460	37,987	40,200	44,500	48,500	Continuing	Continuing

(U) **Mission Description:** This project is a continuation and consolidation of work previously cited under several projects. The objective is to revolutionize far-forward battlefield trauma care. The project recognizes that planned downsizing of U.S. forces creates concomitant pressure to ensure force readiness, skill mix, and effective joint doctrine at a time when battlefield casualties carry both strategic importance and tactical relevance. A review of combat casualty care has shown: (1) that 90% of combat deaths occur in the zone of close combat prior to medical or surgical intervention; (2) that fratricide continues at casualty rates as high as 20%-30%; (3) that casualty location is a continuing battlefield problem; and (4) that less than 5% of U.S. Army active-duty physicians have treated combat casualties.

(U) The ARPA medical technology program has two major segments. The first segment exploits ARPA's unique leadership role in the electronics and information sciences to project advanced medical and surgical care into the far-forward battlefield area to effect early, successful, clinical intervention. In one thrust, this program will develop lightweight personnel status monitors (PSMs) permitting remote non-invasive clinical diagnosis, casualty localization, and friend-foe identification. The PSM, which would be worn by all soldiers as part of their combat uniforms, is further augmented with low power, secure, wireless communications. The PSM would monitor the soldiers' clinical vital signs continuously, but would remain otherwise passive unless either queried by an operational commander or the soldiers' vital signs departed from established clinical norms.

(U) In a second thrust, this program will develop the technology base for early far-forward medical/surgical intervention. The goal is to preserve critical organ system function, prevent exsanguination, reverse systemic shock, and prevent hypoxia by use of automatically controlled devices to provide immediate mechanical or pharmacologic therapy. Once pharmacologic or early surgical stabilization has been achieved, the patient will be evacuated in a critical care pod (CCP) which will function like a single-patient hospital intensive care unit.

(U) In a third thrust, workers will develop and exploit advanced simulation technology to improve the training of battlefield health care providers and to ensure skill currency. The objectives of this effort are to provide for the virtual representation of human structure and function; insure near-seamless transition from training to clinical practice; and to permit simulation of combat-casualty medical care within the framework of operational battlefield

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 2 Exploratory Development	Materials & Electronics Technology, PE 0602712E, Project MPT-07	September 1994

requirements. The broader impact of whole-body virtual simulation on undergraduate and continuing medical education programs will allow military medical students to integrate traditionally separate academic disciplines and dramatically reduce the need for human cadavers.

(U)   Finally, a thrust will develop high-fidelity imaging, particularly in biomedical applications, by the propagation of ultrasound in the medium. The particular problem that is encountered in this imaging modality is that the medium (i.e., human tissue) is inhomogeneous and scatters the signal, which blurs the image. The process for developing high-resolution imaging will build upon the emerging technology of adaptive acoustics.

(U)   In the other segment of the medical technology program, the development of an advanced health care information infrastructure supports the entire trauma care technology base. Medical information must flow seamlessly and transparently on all levels of patient care. For this to occur, a platform-independent medical record system, such as the battlefield electronic patient record (BEPR), will insure immediate continuity, distribution, and accessibility of medical information from the forward battlefield to the rear echelon support in U.S. based medical centers. This information will be archived in multimedia heterogeneous databases of laboratory studies, radiologic and pathologic images, inpatient medical records, and be available over a world wide telecommunication system for real-time interactive collaboration among physicians. In addition, the infrastructure will provide a clinical associate system which is an intelligent system that assists physicians, nurses, corpsmen and paramedics in assessing and treating patients.

(U)   This work does not duplicate any efforts of the military services or the National Institutes of Health.

(U)   **Program Accomplishments and Plans:**

(U)   FY 1994 Accomplishments: Not applicable.

(U)   FY 1995 Program:

- Advanced Biomedical Technology.   ($5.4M)   The basic research portion of this effort is found under PE 0601101E, Project MS-01.
  - Continue development of the personnel status monitor (PSM) primary life state sensors; executive (controller) breadboard; PSM sensor algorithm, code and system integration; medic/command data management

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RDT&E, Defensewide BA 2 Exploratory Development	Materials & Electronics Technology, PE 0602712E, Project MPT-07

and decision support; miniaturized personal communications for Global Positioning Satellite system (GPS) module; interface and integrate communications to controller subsystem; involves in-house and field testing.

- Develop battlefield surgical simulation for lower extremities with emphasis on kinematic realism, soft tissue deformation, muscle contractility and simple bleeding (virtual environment).

- Initiate exploratory studies of telepresence surgery (on experimental model) by wireless link between contingency field hospital and remote field operating room; critical care pod with integrated vital signs monitoring and closed cycle environmental control.   ($9.9M)

- Health Care Information Infrastructure.

  - Develop software architecture for a user-oriented associate system that captures ambulatory care data directly from physicians during patient visits.

  - Develop associate system that provides trauma guidelines directly to medics during emergencies and combat care scenarios.

  - Demonstrate shared electronic, graphic based planning and collaboration tools for multiple users in a distributed health and human services associate system.

(U) FY 1996 Program:

- Advanced Biomedical Technology.   ($16.0M)

  - Continue the development of the personnel status monitor (PSM). Development of enhanced diagnostic capabilities that survey behavioral state of the soldier. Continue evaluation of novel transcutaneous non-invasive biosensor monitoring. Integrate closed-loop control algorithms for fluid infusion and mechanical ventilation support. Design probable conformal versions of the soldier-worn units. Design dismounted combatant version of the PSM for use in dismounted soldier tactical simulation exercises.

  - Continue development of battlefield surgical simulation with the incorporation of trauma mimicry to the trauma extremity simulator simulating physiologic shock and vital organ hypoxia and compromise.

  - Continue development of a working prototype of Remote Telepresence Surgery by the integration of haptic feedback, and orbital lag-time solutions. Develop the structure of the biosensors-based critical care pod into likely form of working prototype that is fully an autonomous critical care system for advanced medivac.

  - Develop battlefield/trauma ultrasonic imaging enhancement to reduce spurious reflections for unambiguous 3D interpretation of body structures.

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RDT&E, Defensewide BA 2 Exploratory Development	Materials & Electronics Technology, PE 0602712E, Project MPT-07

- Continued development of the portable Stat-Lab by additional blood chemistry parameter analytic modules. Development of integrated analytic modules involving optical absorption and absorption assay technology, and cell counting by scattered light. ($12.0M)

• Health Care Information Infrastructure.

- Integrate user-task models and knowledge-based decision support tools.
- Demonstrate hands-free capture of patient data during emergencies.
- Provide one-stop shopping for geographically dispersed human services clients.
- Create reference architecture for generalized associate system.
- Continued development of user-oriented associate systems that allow seamless integration of database sources and user interface development.

• 2-D Ultrasound Technologies. ($4.5M)

- Undertake modeling effort to simulate the propagation, scattering and detection of ultrasound in tissue, utilizing 2-D arrays of detectors.
- Initiate basic features of adaptive acoustics, namely the fabrication of 2-D sensor arrays and appropriate transmit and receive electronics.
- Examine Synthetic Aperitive Radar processing techniques to determine those features which are pertinent to the ultrasonic imaging problem; begin testing algorithms which could mitigate the contribution of multiple scattering sites to image degradation.

(U) FY 1997 Program:

• Advanced Biomedical Technology. ($14.2M)

- Continuation in the development of the personnel status monitor (PSM). Further miniaturization of the Global Positioning Satellite (GPS) module of the PSM in a superchip design which couples a radio data communication chip, for the transmission of vital sign and situational awareness data to battalion level command. Miniaturization of prototype design will continue in coordination with the soldier regalia parameters of the 21CLW program of Secretary of the Army, Research, Development & Acquisition (SARDA). Develop simulation interface of the dismounted soldier's behavioral parameters as measured through the PSM.

- Continued development of battlefield surgical simulation by the incorporation of trauma mimicry, and morphine of the axial trunk musculoskeletal and organ system simulator. Axial trunk simulation of physiological shock, exsanguination and vital organ hypoxia and will focus on the development of an enhanced education and training prototype for the combat medic and the combat surgeon.

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RDT&E, Defensewide BA 2 Exploratory Development	Materials & Electronics Technology, PE 0602712E, Project MPT-07

- Integration of axial trunk and extremity simulators to form entire human body surgical/trauma simulator. A packaging and functional integration between body regions which allows multiple injury response and physiologic mimicry.
- Continued development of a working prototype of Remote Telepresence Surgery. Develop surgical tools for remote telepresence, robotically controlled, and coupled in force-feedback loops for enhanced operational dexterity. Develop fluid and blood sensor-based administration devices for the critical care pod. Develop pharmacologic hibernant sensor-based administration device for drug cocktail injection for the individual combatant. Test of the pharmacologic hibernant under controlled trauma simulations to determine physiologic response with drug-induced reversibility.
- Continued development in medical imaging involving portable Magnetic Resonance Imaging microscope for tissue examination an assessment of pathology. Develop image enhanced chips for application to ultrasonic 3D interpretation. Extend the development of portable digital X-ray to 20x20 cm detector array, for field use.
- Continued development of the assembly of the analytic modules for biological waste, recycling of fluids and the executive controller modules.

• Health Care Information Infrastructure. ($9.0M)
- Demonstrate protocol based care in all outpatient clinics.
- Facilitate transition of combat care associate to emergency services.
- Demonstrate improved life cycle systems management via SEP/DSSA.
- Demonstrate performance gains of advanced software engineering collaborators.

• 2-D Ultrasound Technologies. ($6.3M)
- Continue to develop and implement the techniques of adaptive acoustics to ultrasonic imaging, utilizing 2-D sensor arrays and image processing.

(U) **Program Change Summary:**   *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	0	15.3	28.0	30.0
Current Budget	0	15.3	32.5	29.5

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RDT&E, Defensewide BA 2 Exploratory Development	Materials & Electronics Technology, PE 0602712E, Project MPT-07

(U) **Change Summary Explanation:**

FY 1996   Increase of $4.5M reflects reallocation of funds for the enhancement of effort in the area of 2-D ultrasound technologies.

FY 1997   Reduction of $6.5M reflects minor repricing.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**   N/A

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of
Major Innovative Technologies,
PE 0603226E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Experimental Evaluation of Major Innovative Technologies	592,914	613,331	633,470	677,626	655,306	603,165	690,984	835,798	Continuing	Continuing
Command & Control Information Systems EE-21	500	18,712	28,586	25,700	30,000	39,237	41,687	46,034	Continuing	Continuing
ASTOVL/CTOL EE-24	25,712	20,014	30,887	81,400	83,922	19,000	16,000	10,000	0	N/A
Advanced Space Technology Program EE-27	68,662	5,925	0	0	0	0	0	0	0	N/A
Guidance Technology EE-34	10,809	10,870	26,328	29,844	32,000	17,000	17,000	17,000	Continuing	Continuing
Advanced Ship/Sensor Systems EE-36	17,180	15,885	16,613	33,707	45,614	51,550	53,050	68,050	Continuing	Continuing
Advanced Simulation EE-37	58,001	78,268	74,599	44,585	36,767	44,853	67,653	85,353	Continuing	Continuing
Unmanned Undersea Vehicle Systems EE-39	23,850	18,839	16,950	17,570	17,395	18,115	21,115	26,115	Continuing	Continuing
Critical Mobile Targets EE-40	117,424	122,639	132,146	123,552	121,887	132,360	137,360	146,360	Continuing	Continuing
Air Defense Initiative EE-41	24,642	38,642	43,770	45,036	55,029	55,989	66,989	88,989	Continuing	Continuing
Global Grid Communications EE-45	19,209	45,187	45,493	44,842	43,592	27,916	22,935	24,549	Continuing	Continuing

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Experimental Evaluation of
BA 3 Advanced Development	Major Innovative Technologies,
	PE 060326E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Defense Simulation Internet EE-46	31,617	17,355	27,700	37,390	0	0	0	0	0	N/A
Classified Programs EE-CLS	202,308	220,995	185,398	194,000	189,100	197,145	247,195	323,348	Continuing	Continuing

(U) **Mission Description:** This program element is budgeted in the Advanced Development Budget Activity because its purpose is to demonstrate and evaluate advanced research and development concepts. Eleven projects are funded within this program element such as the Air Defense Initiative, Critical Mobile Targets, Advanced Simulation, and Global Grid Communications projects. A number of advanced concept technology demonstrations are funded within these twelve activities and several projects have dual-use applications. A discussion of the most significant projects follows.

(U) The Air Defense Initiative (ADI) is examining innovative technologies to counter the airborne threat posed by cruise missiles and manned aircraft. Technologies under evaluation include sensor upgrades, data integration and identification improvements, and radar-absorbent materials research. Advanced infrared measurement and high resolution digital imagery systems are also under development, and a simulation and modelling effort is included to test and demonstrate ADI concepts.

(U) Advanced Simulation efforts will provide a distributed, scalable seamless warfighting environment at the weapon level of detail that will ultimately provide a massive synthetic theater of war capable of supporting such requirements as readiness training, doctrine refinement, requirements analysis, battle management simulation, and contingency planning. Communications and data infrastructures, range instrumentation and computer image generation are just a few of the developmental activities funded in the Advanced Simulation program.

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(U)   The Critical Mobile Targets (WAR BREAKER) project is developing a comprehensive system of sensors, communication suites, and information processing systems to detect, identify, and prosecute high value, time-critical fixed and mobile targets such as theater ballistic missiles, tanks, and artillery.

(U)   The Global Grid Communication project will develop and demonstrate advanced communications technologies needed for defense and intelligence operations for the 21st century.   The ultimate goal is deployment of a gigabit network that will be interoperable with commercial, optical and secure wireless networks.

(U)   This program element also includes efforts in Command and Control Information Systems, advanced ship/sensor systems, Unmanned Undersea Vehicles, advanced Guidance/Targeting technologies, and the Defense Simulation Internet.

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R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Command Control Information Systems EE-21	500 *(6,733) **(3,000)	18,712 *(0) (9,925)	28,586	25,700	30,000	39,237	41,687	46,034	Continuing	Continuing

*Speakeasy was funded in PE 0602702E, (TT-07) in FY 1994.
**IMPACT was funded in PE 0603226E (EE-27) in FY 1994 and FY 1995.

(U) **Mission Description:** Desert Storm and Provide Hope operations demonstrated that current theater command, control, communications and intelligence/information systems lack the ability to support critical interoperable, wide-area communications to the mobile commander. Additionally, these systems fail to provide real-time situational awareness, decentralized battle execution capability, and flexible interfaces. These infrastructure shortfalls are particularly acute during early entry operations when the availability of situational awareness information and military communications assets are most limited.

(U) On-going Advanced Technology Demonstrations being conducted by the Army will provide enhancements based on existing communication systems e.g., Single Channel Ground and Airborne Radio Systems (SINCGARS) that will allow horizontal integration of Army elements and the synthesis of electronic maps showing the location of all friendly Army units. The programs in this project will extend that capability to include information concerning enemy and friendly forces and provide joint, wide-area, multimedia information. This project will provide a rapidly-deployable, affordable system covering a large (~200 mile) operational area and be capable of providing a joint common situational awareness picture, battlefield synchronization tools, and multi-media information interfaces to on-the-move users.

(U) This project comprises four programs: the Commercial Communications Technology Demonstrations (IMPACT), and the Command and Control Information System (C²IS) (formerly Battle Command Initiative).

(U) The C²T² will extend the capabilities developed in the C²IS, which are intended primarily for use by commanders, down to individual dismounted soldiers. The C²T² will focus on providing local coordination and targeting information to as well as a system and a process for evaluating commercial communications products for dismounted applications through a "plug and play" interface. The system will provide dismounted soldiers with a

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wearable suit including heads-up and wrist-mounted displays and micro-processors to provide position/location and image transfer capabilities. Because the system will have both short and long-range communications, it will be used to evaluate multi-squad coordination, soldier interactions with remote sensors and weapons, and special situations such as air/ground data transfer for rapid-response coordinated attacks on snipers, mortars, and ambush teams. This is being performed in conjunction with the Army's Twenty-First Century Land Warrior, and is expected to provide an evaluation of applicable products and improved definition of system requirements.

(U)   Speakeasy is a program to develop a multi-band, multi-mode programmable digital radio capable of communicating with a wide variety of existing military and civilian radios. Initially, this will allow units to communicate across the Services. As Speakeasy is proliferated, it will allow increased rates of data transfer to occur. This will improve data flow within and across Services and result in long-term cost savings by allowing a common tri-Service radio which is interoperable with existing systems in each of the Services. Speakeasy will inter-operate with all elements of the C²IS as well as with existing legacy systems to provide enhanced connectivity, and will provide service in situations where commercial communications may be inadequate, for example, where special anti-jam or low-probability of intercept communications are needed. Relevant IMPACT technology will be inserted in Speakeasy.

(U)   IMPACT, formerly in project EE-27, is a multi-disciplinary program to enhance Satellite Communication (SATCOM) support to Command and Control by leveraging advanced technology to reduce the life-cycle costs of all military satellite communications (MILSATCOM) terminals with associated reductions in size, weight, and power consumption and increased performance, reliability and capability. The program focuses on broad technology efforts that span all MILSATCOM terminal programs with initiatives to enable next generation terminals. IMPACT thrusts will benefit all MILSATCOM terminals and many commercial products. Thrusts include: affordability (personnel cost avoidance through autonomous operation); interoperability (programmable radio architectures to enable simultaneous multi-mode, multi-band operations); enhanced mobility (via miniaturization) and high performance capabilities (very high data rate communications). IMPACT will provide support across the spectrum (UHF, SHF, and EHF) and across all terminal classes (fixed site, mobile, manpack, airborne, shipborne, etc.).

(U)   C²IS will develop battlefield synchronization tools and technology to support joint in-time situational awareness, decentralized battlefield execution, flexible and responsive man-machine interfaces, and wide-area multi-media data access and communications for on-the-move tactical users. The development focus is on Early Entry missions with extensions to address capability and technology gaps. Core capabilities include: display and maintenance of red, blue and white force positions; projection of locations based on a priority doctrine; automatic

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call routing; database synchronization; assessment of combat effectiveness; speaker independent voice interface; doctrine discovery; and intelligent agents which adapt to individual commanders and evolve with training and simulation experience. C²IS will develop multiple granularity displays, assessment, projection, and course of action analysis (including simulation over networks) capabilities to enhance battlefield synchronization and address varying requirements of different echelons, e.g., timeliness and resolution. C²IS serves as the integrating concept and mechanism for the functional and communications capabilities being developed in the other projects in this PE. To achieve affordability, the effort will leverage commercial and consumer technologies to the extent possible (e.g., emerging spread spectrum cellular communications and personal data assistants). These will pass information to and from battlefield systems such as the Common Ground Station and the Battle Command Vehicle to provide the necessary data access and correlation capabilities. This effort will be conducted in conjunction with an architecture and database evaluation environment performed in project EE-37, which will be incorporated in this PE in FY 1997, and will use technologies developed in Program Element 0602702E, Advanced Land Systems Technology, project TT-04.

(U)   **Program Accomplishments and Plans:**

(U)   **FY 1994 Accomplishments:**
*   Investigated advanced fire detector systems and fire suppressants for metal fires.   ($.25M)
*   Investigated innovative methods and techniques for monitoring nuclear waste.   ($.25M)

(U)   **FY 1995 Program:**
*   In conjunction with Battle Labs, perform detailed analysis of C²IS and its information, interface and interconnect requirements, space technology and subsystems; use Early Entry scenarios to specify technology gaps; evaluate and select technology being developed in TT-04 in C²IS system context, and; establish C2IS testbed as adjunct to Battle Command Battle Lab testbed.   ($2.5M)
*   C²T²: Conduct squad level demonstrations of leveraged advanced civilian personal communications and computation technology for dismounted soldiers and vehicles, in military operational training/test environment. Link situation awareness and intelligence to ground soldiers.   ($9.2M)
*   Speakeasy: Complete the development and integration of the advanced technology modules into the Speakeasy Advanced Development Model (ADM), Phase I; demonstrate a fully integrated ADM; award Speakeasy Phase II contract.   ($7.0M)

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(U) **FY 1996 Program:**

- Design and develop multiple granularity display and assessment capabilities; design projection and course of action analysis subsystems. In conjunction with Battle Labs, evaluate component concept demonstrations with Early Entry scenarios at the operational level. Design and plan demonstration of integrated C²IS, Speakeasy, C²T², and IMPACT technology at operational and tactical level. ($5.1M)

- Continue the development of advanced technologies for the Speakeasy Prototype Radio and hold preliminary design review. Conduct operational concept demonstration with emphasis on full electronic reprogrammability to achieve interoperability with existing military radios. ($8.5M)

- Demonstrate C²T² in the integrated demonstration provided by the battle management environment. Evaluate C²T² impact on integrate execution of SOF and tactical operations for efficiency of concurrent operations and fratricide avoidance. Link heliborne reconnaissance and mine detection to ground units for prosecution. ($8.4M)

- Continue technology developments for IMPACT and complete developments for Low-Cost, Low-Power Vocoder, Advanced Multi-mode Modem Study, Low Noise Amplifier, Fast-Hopping, Low-Power Digital Synthesizer. Transition technologies to Speakeasy as appropriate. ($6.6M)

(U) **FY 1997 Program:**

- Continue development of component C²IS technology and conduct demonstration of integrated C2IS at operational level. Transition technology at battalion level. ($7.5M)

- Continue development of hardware and software technology for the Speakeasy Prototype Radio and conduct critical design review. Transition technology. ($9.7M)

- Complete integration of C²T² and transfer stand-alone technology. ($2.7M)

- Continue technology development for IMPACT and complete development for Advanced MILSATCOM Maintenance Software for Diagnostics/Fault Isolation, Integrated Photonic Time Delay Module. ($5.8M)

(U) **Program Change Summary:** (In Millions)

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	.5	24.7	33.8	44.0
Current Budget	.5	18.7	28.6	25.7

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development		**R-1 ITEM NOMENCLATURE** Experimental Evaluation of Major Innovative Technologies, PE 060326E, Project EE-21

(U)   **Change Summary Explanation:**

   FY 1995   Decrease of $6.0 million reflects reprogramming of funds to Tier 3 in project EE-CLS.
   FY 1996/97 Decreased to provide funds for higher priority programs.

(U)   **Other Program Funding Summary Cost:**   N/A

(U)   **Schedule Profile:**

   Plan   **Milestones**
   Oct-Dec 95   Soldier testing of commercial communications system for dismounted operations and assessment of
                alternative missions.
   Mar 96   Preliminary design review of Phase II Speakeasy system.
   Sep 96   Conduct demonstrations of C²IS multiple granularity display and analysis subsystems with Early
                Entry scenarios.
   Sep 96   Complete low-cost low power vocoder.
   Oct-Dec 96   Demonstrate novel advanced warfighting concepts using the commercial communications testbed.
   Mar 97   Critical design review demonstration of Phase II Speakeasy.
   Sep 97   Complete MILSATCOM maintenance software.

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RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
X-32 STOVL/CTOL Common Affordable Lightweight Fighter EE-24	25,712	20,014	30,887	81,400	83,922	19,000	16,000	10,000	0	N/A

(U) **Mission Description:** The X-32 STOVL/CTOL Affordable Lightweight Fighter project is investigating a single engine, lightweight, affordable strike aircraft to potentially replace the AV-8B, F-16, and F/A-18. The X-32 will have two variants: a Short Takeoff, Vertical Landing (STOVL) variant (X-32B) for the Navy and Marine Corps, and a Conventional Takeoff and Landing (CTOL) variant (X-32A) for the Air Force. These variants would share a common engine, airframe and avionics. The STOVL propulsive lift system would be eliminated from the Air Force variant and replaced with additional fuel capacity. Major performance goals include: Weight Empty: <24,000 lb; Size: <F-18C; Powerplant: derivative of the F-119 or YF-120 Advanced Tactical Fighter Engine; maneuvering and airspeed flight envelope equal to or greater than the F-18; Flyaway cost: significantly less than the F-18C. Performance levels will be traded against cost to ensure affordability of the aircraft. This aircraft will be modular to the extent that the propulsive lift system will be designed to be removed and replaced with additional fuel capacity for Air Force CTOL use. It is estimated that 95% of the parts in the Air Force variant will be common to the STOVL variant.

(U) The ongoing ARPA/Navy critical technology validation design refinements, analyses, and testing are directed toward risk reduction which, if successful, will set the stage in FY 1996 for ARPA, The Joint Advanced Strike Technology (JAST) Program, and the British Ministry of Defence to cooperatively develop and flight test prototype X-32A and B strike aircraft. A competitive procurement to select a single prime contractor for this effort is planned to be conducted early in FY 1996 as soon as large scale testing results are available. It is planned to use the ARPA Agreements Authority as the contracting vehicle for development of this prototype.

(U) **Program Accomplishments and Plans:**

(U) **FY 1994 Accomplishments:**

- Conducted small scale w nd tunnel model testing and large scale propulsion model fabrication for the Shaft Coupled Lift Fan Concept. ($9.9M)
- Conducted small scale wind tunnel model testing and large scale propulsion model fabrication for the Gas Coupled Lift Fan Concept. ($9.8M)

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- Performed direct lift concept design analysis and small scale component testing. ($6.0M)

(U) **FY 1995 Program:**
- Initiate large scale wind tunnel tests and large scale propulsion system tests for the Shaft Coupled Lift Fan Concept. ($11.4M)
- Initiate large scale wind tunnel tests and large scale propulsion system tests for the Gas Coupled Lift Fan Concept. ($8.6M)

(U) **FY 1996 Program:**
Phase II:
- Complete critical technology validation program for the Shaft and Gas Coupled Lift Fan Concepts. ($1.9M)

Phase III:
- Conduct detailed demonstrator aircraft design. ($6.0M)
- Begin long lead procurement and fabrication of propulsion system components. ($23.0M)

(U) **FY 1997 Program:**
- Begin engine ground testing, complete detailed demonstrator aircraft design and begin aircraft fabrication. ($81.4M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	25.7	20.0	2.0	0.0
Current Budget	25.7	20.0	30.9	81.4

(U) **Change Summary Explanation:**

FY 1996-97 Funding increase reflects Phase III of the program, X-32 Technology Demonstrator Design, Fabrication, and Flight Test.

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(U) **Other Program Funding Summary Cost:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
Navy PE 0603217N (W2152)	11.1	8.6	2.8	0
United Kingdom	12.0	0.0	0.0	0

(U) **Schedule Profile:**

Planned   **Milestones**

May 95	Jet Induced Effects Model Testing Complete.
Jun 95	Propulsion System Component Testing Complete.
Jul 95	Commence Large Scale Propulsion Model Testing.
Jan 96	Large Scale Propulsion Model Testing Complete.
Mar 96	Downselect to single Phase III contractor.
May 96	Begin Aircraft Design, Fabrication, and Flight Test.
Oct 97	Begin Engine Testing.

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R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Space Technology System EE-27	68,662	5,925	0*	0	0	0	0	0	0	N/A

*In FY 1996 and subsequent years the IMPACT Program is funded in PE 0603226E, project EE-21.

(U) **Mission Description:** The Advanced Space Technology Program (ASTP) is aimed at achieving an affordability breakthrough in the development, launch and operation of satellite systems. To date, the goals have been to demonstrate low cost access to space with small launch vehicles; reduce the size, weight, power and cost of satellite components; and demonstrate first-generation lightweight satellite capabilities. This phase has formed a prerequisite technology foundation and has produced two new launch vehicles (the Pegasus Air-Launched Vehicle and the Taurus Standard Small Launch Vehicle), 10 small satellites and numerous advanced, miniaturized components. This phase of the program will conclude with the launch of Taurus, on-orbit demonstration of DARPASAT and completion of the remaining technology projects.

(U) IMPACT is a multidisciplinary development program aimed at leveraging advanced technologies to reduce the life-cycle costs of all military satellite communications (MILSATCOM) terminals with associated reductions in size, weight and power consumption of MILSATCOM terminals and increased performance, reliability and capability. The program addresses broad technology efforts that span all MILSATCOM terminal programs with technology initiatives in support of next-generation terminals.

(U) The themes and objectives of the IMPACT program will benefit all MILSATCOM terminals, as well as many commercial products. These themes include affordability (personnel cost avoidance through autonomous operation), interoperability (programmable radio architectures to enable simultaneous multimode, multiband operations), enhanced mobility (via miniaturization) and high-performance capabilities (very high data rate communications). The program will provide support across the spectrum (UHF, SHF and EHF) and across all terminal classes (fixed-site, mobile, manpack, airborne, shipborne, etc.).

(U) The Congressionally directed Tactical Support Satellite (TSS) program will conduct a competitive system concept definition effort which will provide cost effective solutions to address the Joint Chief of Staff's highest requirement priorities for TSS. Tactical concepts of operation will be developed. Key concepts include direct satellite tasking and receipt of data by the Joint Force Commander.

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Experimental Evaluation of Major Innovative, Technologies, PE 0603226E, Project EE-27

(U)   The Congressionally directed Launch Vehicle Technologies program is oriented towards identification and demonstration of unique and innovative launch concepts (e.g. parafoils) and launch subsystems (e.g. hybrid propellants) which would not otherwise be explored within the launch community. The goal of this effort is to demonstrate technologies which would enable significant cost reduction in acquisition and O&M to enhance vehicle reliability responsiveness assuring rapid access to space.

(U)   The Congressionally directed Single-Stage-to-Orbit program is aimed at establishing a competitive reusable space launch technology base for the United States through high risk technology demonstration activities proposed by U.S. industry. This effort has also been directed to complete the DC-X "Delta Clipper" flight test program. This effort will be directed at a range of diverse technology demonstrations oriented toward resolving fundamental reusable space launch technology issues.

(U)   The Congressionally directed Large Millimeter Wave Telescope is a potential joint United States/Mexico program to build and operate an adaptive, high precision, wide bandwidth, 50-meter aperture millimeter wave radio telescope. The sites being considered in Mexico offer low humidity and ability to view both northern and southern skies. This telescope is being designed for a 1 arcsec pointing accuracy, which, if achieved, would better the current state-of-the-art for radio telescopes.

(U)   **Program Accomplishments and Plans:**

(U)   FY 1994 Accomplishments:

- Conducted the launch of Taurus; initiated demonstration program for DARPASAT.   ($2.4M)
- Continued technology development for IMPACT.   ($2.9M)
- Initiated TSS system concept definition.   ($9.9M)
- Initiated development of launch vehicle technologies.   ($9.8M)
- Initiated the Large Millimeter Wave Telescope design study.   ($3.0M)
- Built and tested a miniature version of the current shortwave infrared sensor.   ($0.7M)
- Concluded DC-X flight test program at WSMR on 6/27/94.   ($5.1M)
- Planned and coordinated Reusable Space Launch Technology (ReSLT) Program.   ($34.9M)

(U)   FY 1995 Program:

- Continue technology developments for IMPACT; conduct technology design reviews.   ($5.9M)

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(U) **Program Change Summary:**   *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	28.7	5.9	7.0	6.0
Current Budget	68.7	5.9	0	0

(U) **Change Summary Explanation:**

FY 1994   Increase reflects the Congressional disapproval of the proposed rescission of the Single-Stage-to-Orbit ($40.0 million) Program.

FY 1996-97 Adjustments reflect the transfer of the IMPACT program to EE-21, Command, Control Information Systems.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile**

Plan   **Milestones**
Mar 95   Complete demonstration of DARPASAT.
Mar 95   Transition the DARPASAT to user.
Dec 95   Complete IMPACT Design Reviews.

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COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Guidance Technology EE-34	10,809	10,870	26,328	29,844	32,000	17,000	17,000	17,000	Continuing	Continuing

(U) **Mission Description:** Fire-and-forget stand-off weapons need precise targeting information if critical fixed and mobile targets are to be eliminated effectively and with minimal collateral damage and minimum cost-per-kill. This requires that: (1) military surveillance and targeting systems geo-locate targets accurately in the same coordinate system (i.e. WGS-84) in which the weapon system navigates; (2) the weapon system has a precision navigation and guidance system on-board, plus weapons with effective endgame seekers; and (3) navigation and target location systems cooperate day/night and in adverse weather. In addition, future systems designed to accomplish precision strike missions must be significantly more affordable. The achievement of these characteristics in an integrated system is the goal of this program. The advanced navigation and guidance technologies being developed in support of this goal are the Global Positioning System (GPS) Guidance Package (GGP), Common Grid, and Sharpshooter. GGP and Sharpshooter technologies are applicable for new or retrofit guidance/navigation packages for aircraft and weapons. Common Grid benefits all GPS users in a combat zone.

(U) GGP is the core component of the guidance technology project. It tightly integrates a miniature GPS receiver (MGR) and an all solid state, low cost, navigation-grade, interferometric fiber optic gyroscope (IFOG) based miniature inertial measurement unit (MIMU) with an advanced navigation computer into a potentially low cost ($15,000), precision navigation system. GGP Phase 1 addresses the technology issues involved in: (1) miniaturizing inertial grade inertial measurement units (IMUs) into a compact, manufacturable configuration; and (2) developing a multi-channel-on-chip, high dynamics MGR. A Memorandum of Agreement (MOA) in process, outlines a demonstration of a Phase I unit with the Army Bradley Fire Support Team Vehicle (FIST-V). GGP Phase II requirements place more stressing demands on performance of MIMM components and call for further reductions in size, power, and weight. A MOA is in process with the Naval Air Systems Command (Common Avionics). GGP is relevant to the Advanced Integrated Navigation and Control Package.

(U) Common Grid will develop a set of mobile low cost, local GPS reference broadcast stations to coordinate precision targeting with weapon delivery systems. Common Grid will augment the baseline GPS capability within a theater of operations and will move forward with forces as they advance in theater. It enables the passing of very accurate targeting date (1-to-3 meters CEP relative location error) without the need for real time direct

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communications between specific sensors and specific shooters. Common grid addresses the technology issues associated with: (1) developing a miniature, low power atomic clock; (2) integrating the GPS receiver with the atomic clock and other supporting equipments; and (3) appropriately modeling the impact of phenomenological variations, staleness of ephemeris data and relaxation of user location precision after leaving the grid's coverage.

(U)   Sharpshooter will demonstrate an integrated, advanced technology, precision strike capability. It will synergistically combine affordable advanced navigation guidance (e.g. GPS Guidance Package -GGP) with commercial off-the-shelf seeker technologies. The importance of minimizing collateral damage and fratricide as well as coping with the adverse effects of weather was dramatically illustrated in Desert Storm and other more recent operations. The high cost of today's guided weapons is largely driven by the need for complex, expensive seekers to compensate for weapon navigation system inaccuracies, target location uncertainties and poor weather conditions. These seekers need to operate at long-ranges with wide search areas and large processing loads. Accurate navigation and guidance, using GPS and solid state inertial navigation technologies, will enable more accurate target location and provide seeker operations at shorter ranges with smaller search areas and smaller processing loads. This program will demonstrate range-invariant, 3-meter circular error probable guidance accuracy in integrated carrier platform, weapon, and seeker configurations. Results of the GPS Guidance Package (GGP), Common Grid, and relevant manufacturing technology programs will be integrated and exploited to demonstrate the simplest, most affordable terminal seekers to satisfy the 3-meter CEP demonstration goals.

(U)   **Program Accomplishments and Plans:**

(U)   FY 1994 Accomplishments:
- Completed GPS Guidance Package (GGP) Phase 1 brassboard fabrication and laboratory tests.   ($5.2M)
- Initiated GGP Phase 2 contract actions to further reduce GGP in size, weight, power consumption and cost. ($.3M)
- Completed Multifunction Self-Aligned Gate (MSAG) technology for military applications.   ($4.0M)
- Initiated preparation activities to test GGP on the Army Fire Support Team Vehicle (FIST-V).   ($.6M)
- Investigated GGP applications.   ($.7M)

(U)   FY 1995 Program:
- Complete preparation and test GGP on the Army (FIST-V).   ($.3M)
- Initiate and complete Government laboratory and field evaluations of GGP Phase 1 brassboards.   ($.4M)

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- Develop GGP Phase 2 critical components and conduct preliminary design review. ($7.2M)
- Design Common Grid elements and demonstrate critical subsystem feasibility. ($2.9M)

(U) FY 1996 Program:

- Conduct Global Positioning System (GPS) Guidance Package (GGP) Phase 2 critical design review. ($4.5M)
- Develop GGP Phase 2 brassboard demonstration unit. ($8.0M)
- Continue Common Grid component feasibility demonstrations and complete design. ($5.4M)
- Initiate Common Grid system brassboard development. ($.4M)
- Initiate Sharpshooter flyable brassboard design. ($8.0M)

(U) FY 1997 Program:

- Continue GPS Guidance Package (GGP) Phase 2 fabrication and integration testing. ($11.0M)
- Continue Common Grid system brassboard development and begin testing. ($6.8M)
- Complete Sharpshooter design and begin fabrication. ($12.0M)

(U) **Program Change Summary:**   (In Millions)

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	10.1	10.9	18.9	18.0
Current Budget	10.8	10.9	26.3	29.8

(U) **Change Summary Explanation:**

FY 1994   Increase of $0.7 million to investigate GGP applications.
FY 1996-97 Initiate and continue developments leading to Sharpshooter demonstrations.

(U) **Other Program Funding Summary Cost:**   N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-34	September 1994

(U) **Schedule Profile:**

Plan   **Milestones**

Plan	Milestones
Nov 94	Global Positioning System (GPS) Guidance Package (GGP) Phase 1 brassboard delivery.
Nov 94	Government brassboard tests begin.
Jan 95	GGP Phase 2 award.
Apr 95	Initiate Common Grid design.
Aug 95	GGP Phase 2 preliminary design review.
Mar 96	Initiate Sharpshooter flyable brassboard design.
May 96	GGP Phase 2 critical design review.
Jul 96	Complete Common Grid component feasibility demonstration; initiate system brassboards.
Mar 97	Complete Sharpshooter design and begin fabrication.
Jan 98	GGP Phase 2 contractor testing.
Mar 98	Complete Sharpshooter flyable brassboard demonstration.
Apr 98	GGP Phase 2 brassboard delivery.
May 98	Common Grid government brassboard tests begin.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
ASW Technology EE-36	17,180	15,885	16,613	19,396	22,614	22,550	33,050	68,050	Continuing	Continuing

(U) **Mission Description:** Major changes in the worldwide defense environment, due to the spread of sophisticated military technology to third world countries and the need to support littoral warfare, require the enhancement of U.S. capabilities in shallow water anti-submarine warfare (ASW), littoral warfare scene management, and advanced mechanical systems. This project develops and demonstrates advancements in acoustic signal processing, active shock and vibration control, advanced sensor and actuator materials, and high performance computing technologies. These advances will significantly enhance the capabilities of naval and maritime forces to support future U.S. missions and enable the U.S. to more effectively project and operate these forces in a broader range of tactical environments.

(U) The project focuses on three areas of development: Sonar Technology, ASW Scene Management, and Advanced Ship Mechanical Systems. In the Sonar Technology area, applications of advanced object detection, classification, and localization technologies using High Performance Computing (HPC) are demonstrated. Active and passive sonar techniques are applied, using advanced sources and sonar systems built from distributed elements or concentrated arrays. These applications will result in enhanced ASW capability against diesel-electric submarines operating in shallow water. In the ASW Scene Management area, advanced signal processing techniques are utilized which integrate real-time information with background intelligence to provide a complete picture of the shallow water operational situation. In the Advanced Mechanical Systems area, technologies such as precision active structural controls, actuator and sensor systems and high speed digital signal processing are developed. These technologies will result in reduced ship acoustic signatures, high performance/ high reliability propulsion systems, and increased ship system affordability.

(U) **Program Accomplishments and Plans:**

(U) **FY 1994 Accomplishments:**

- Completed a test to determine the limits of shallow water multistatic sonar. Continued development of automatic multistatic active shallow water processors for tactical sonars. ($5.1M)

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		DATE
		September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Experimental Evaluation of Major Innovative
BA 3 Advanced Development	Technologies, PE 0603226E, EE-36

- Planned and participated in conduct of the Navy's activated Fixed Distributed System (FDS) test to demonstrate future advanced multistatics signal processing techniques. Initiated planning efforts and fleet liaison for a fleet Anti-Submarine Warfare (ASW) demonstration of shallow water processing technologies. ($2.3M)

- Applied signal processing techniques to diesel electric submarine echoes and radiated noise measurements and began development of automatic classifiers for diesel electric submarines. ($.4M)

- Initiated shallow water ASW total scene management efforts. ($1.2M)

- Developed and initiated testing of a polymer-based transducer. ($2.7M)

- Completed development and testing of shallow water impulsive source technology. ($1.0M)

- Planned for development and demonstration of vibration cancellation and seaway motion imbalance control techniques for aeroderivative gas turbine engine. This effort was funded by a Congressional addition to the FY 1994 President's Budget. ($4.5M)

(U) FY 1995 Program:
- Continue development and testing of autonomous multistatic active processors for shallow water environmental tactical sonars. ($4.6M)
- Complete conduct of proof-of-concept tests and assess performance of multistatic active processing technologies. Complete planning of fleet ASW demonstration. Develop processor for demonstration and initiate conduct of demonstration. ($3.7M)
- Continue development of autonomous diesel electric submarine detection and classification technologies and conduct laboratory demonstration of candidate systems. ($.9M)
- Apply scene management technologies to the multistatic active system and test high frequency tactical active sonar processing and scene generation capability. ($3.5M)
- Continue development and testing of polymer transducer array. ($1.7M)
- Continue development of impulsive sources by extending to very shallow water and environmental adaptability. ($1.5M)

(U) FY 1996 Program:
- Complete development of multistatic active adaptive processing for shallow water tactical sonars. ($3.5M)
- Conduct fleet Anti-Submarine Warfare (ASW) demonstration of multistatic active tactical processor. ($1.5M)
- Initiate development of automated multi-array processing system. ($3.0M)
- Complete ASW scene management design and develop scene management system. ($6.5M)
- Initiate planning for ASW scene management demonstrations. ($1.1M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-36

- Initiate Mechanical Technology Initiative Concept Feasibility Studies to determine technology roadblocks and technical approaches, define feasibility critical experiments, and identify payoffs. ($1.0M)

(U) FY 1997 Program:

- Conduct final at-sea ASW demonstration of environmentally adaptive shallow water active sonar technology. ($2.5M)
- Complete proof-of-concept system of automated multi-array processing system and plan for FY 1998 demonstrations. ($5.1M)
- Conduct ASW total scene management tests and demonstrations. ($5.1M)
- Conduct Mechanical Technology Initiative Critical Experiments to determine feasibility of selected technology concepts. ($3.0M)
- Develop Signal Processing and Classification algorithms based on marine mammals ability to detect and classify buried objects. ($3.7M)
- Perform concept feasibility demonstration for special warfare weapon stabilization and isolation system. ($2.4M)
- Demonstrate active mount technology for shock and vibration suppression of turbine rotating components on large-scale vehicle or platform. Perform concept feasibility demonstration on ASC system for turbine engine external structural components. ($4.4M)
- Complete full-scale demonstration of ASC system for precision grinding operation on noise-critical component. ($1.2M)
- Perform large scale demonstration of dynamically stiffened maritime structures and concept feasibility demonstration of ASC system for robotic manipulators. ($6.3M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	17.2	15.9	16.5	16.9
Current Budget	17.2	15.9	16.6	33.7

(U) **Change Summary Explanation:**

FY 1997   Increase reflects the transfer of funding related to the Mechanical Technology Initiative from Advanced Anti-Submarine Warfare (ASW) Technology, PE 0603226E, Project No. AS-01.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-36	September 1994

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**

Plan   **Milestones**

Sep 95   Conduct at-sea testing of an active acoustic system for shallow water environment.

Sep 95   Conduct testing for polymer transducer array.

Sep 95   Continue development and testing of Anti-Submarine Warfare (ASW) scene management system.

Jun 96   Complete ASW scene management system development.

Jul 96   Complete Concept Feasibility Studies for Mechanical Technology Initiative.

Jul 96   Complete development of multistatic active adaptive processing for shallow water tactical sonars.

Aug 96   Complete Large-Scale Demonstration of advanced Aeroderivative Engine active control technology.

Oct 96   Begin Selected Critical Feasibility Demonstration Experiments for Mechanical Technology Initiative.

Nov 96   Conduct final at-sea demonstration of an active acoustic system for shallow water environment.

Mar 97   Conduct testing of biologically-based transmitter and receiver concepts.

Jun 97   Conduct ASW scene management system at-sea demonstrations.

Jun 97   Complete proof-of-concept of automated multi-array processing system.

Jul 97   Complete development and demonstration of adaptive arrays.

Sep 97   Demonstrate bio-sonar signal processing and classification algorithms.

Sep 97   Complete Critical Feasibility Demonstration Experiments for Mechanical Technology Initiative.

Aug 97   Demonstration of active vibration control system for precision grinding operation.

Jul 98   Conduct ASW scene management system at-sea transition demonstrations.

Aug 98   Full-scale demonstration of turbine active vibration control system for engine mounts and external components.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: September 1994

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major Innovative
Technologies, PE 0603226E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Simulation EE-37	58,001	78,268	79,599	44,585	36,767	44,853	67,653	85,353	Continuing	Continuing

(U) **Mission Description:** The strategic environment in which the United States operates has changed. The new strategy places emphasis on joint crisis response and requires coordinated joint and service training programs to ensure readiness. At the same time, resources will continue to shrink, requiring the Department to search for the most cost effective ways to address the threat across the full spectrum of military activity. To support the new National Military Strategy, the Advanced Distributed Simulation program is developing as its legacy the advanced interoperable technologies to effectively and efficiently construct, on demand, a robust variety of synthetic environments that will enable fundamental changes in how mainline defense functions are accomplished in the year 2000 plus. The ultimate goal is to provide cost effective tools and standards necessary to create a seamless warfighting simulation environments at the weapons system level of detail capable of representations of a theater of war supporting the following functions: Joint/Service readiness training; Joint/Service doctrine refinement and development; requirements analysis; design, prototyping and manufacturing; and contingency planning, operations, after action review, early entry command and control information system for battle management and historical analysis. The focus is on the development and integration of key technologies such as environmental representation, semi-automated forces, simulation scaleability, information technologies, range instrumentation, and simulation based engineering. As technologies mature, they will be demonstrated and tested in joint theater of war exercises of increasing size, complexity and utility. STOW 97, an Advanced Concept Technology Demonstration (ACTD), is the first of several technology demonstrations and focuses technology developments on improving the conduct of joint training and mission rehearsal and includes live, virtual and constructive simulation on a seamless, synthetic battlefield.

(U) The environmental representation program concentrates on the creation of synthetic environments for simulation including representation of both static and dynamic terrain, weather and environmental phenomena, diurnal variations and dynamic terrain. The semi-automated forces create a scaleable computer-generated military force that is representative and behaviorally accurate with resolution of battle outcome at the weapon system level of detail. Scaleability efforts investigate and develop technological solutions to create a robust network interconnection capable of accommodating a wide range of simulation goals and network demands. The information technology development concentrates research and development in areas contributing to providing the communications infrastructure capable of supporting 100,000 entities interoperating with each other in perceptible real time.

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RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-37

The early entry command and control information systems technology development relates to development of a robust simulation environment capable of situational representations facilitating evaluations of a multi-level, joint battle management system. The range instrumentation project addresses the problem of interfacing live vehicles to the synthetic environment. The integrated product and process development simulation provides a distributed toolbox of simulation tools linking concurrent engineering of land vehicles with the warfighting environment.

(U) The Synthetic Theater of War Program demonstration scheduled for calendar year 1997, an integral element of the Advanced Simulation Technology Program, has been designated an Advance Concept Technology Demonstration (ACTD) by the Deputy Under Secretary of Defense for Advanced Technology.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

• Demonstrated, produced, tested, and prototyped interim expanded network information flow technologies capable of supporting up to 3,500 interactive, dynamic entities on the synthetic battlefield. Demonstrated the simulation technologies enabling the interoperation of higher-level aggregated simulation (classical simulations) with company networks of individual platform level simulators and company/battalion-level semi-automated forces. Prototyped network analysis and scenario initialization tools. ($3.4M)

• Demonstrated prototype environmental phenomena (smoke) effecting behavior of semi-automated forces; created large-scale terrain data base using new efficient representation technology (TIN); created experimental high-fidelity 1 meter terrain data base with vertical accuracies of less than .15 meters; initiated environmental representation research. ($4.3M)

• Demonstrated working semi-automated forces for a limited range of combat specific entities that were behaviorally accurate at a primitive level; initiated development of a synthetic forces sub-architecture capable of supporting the creation of complex joint simulations. ($13.2M)

• Demonstrated interoperation of simulated warfighting environment with service C3I systems in large-scale simulated maneuver exercises. ($.8M)

• The STOW-E (Synthetic Theater of War - Europe) exercise demonstrated integration of virtual warfighting simulation, constructive and live instrumented ranges. Initiated development of future Advanced Distributed Simulation Architecture. ($19.3M)

• Initiated the development of a Distributed Interactive Simulation (DIS) based architectural framework in which to demonstrate critical simulation technologies enabling cost effective, large scale, distributed

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RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-37

simulations capable of addressing a broad range of defense functions. The function of the architecture is to serve as an integrating framework for existing sub-architectures and new sub-architectures as required. ($2.4M)

- Demonstrated interactivity of high performance aviation in a virtual simulation. ($.4M)
- Initiated the Congressionally directed virtual Brigade Program for the development of a training development program to determine the optimum mix of training aids, devices, simulations, simulators and field training to intensify conventional training methods for an armored brigade. ($14.2M)

(U) FY 1995 Program:

- Continue to design, analyze, test, and demonstrate solutions promoting the growth of robust networks accommodating the unique demands of 5,000 interactive, dynamic entities operating in a coherent manner distributed across local, metropolitan, and wide area networks. Provide technical solutions promoting dial-up networking of heterogeneous simulations, simulators, and operational equipment. ($5.1M)
- Continue development of an environmental sub-architecture consistent with advanced distributed simulation development; demonstrate prototype environmental representation integrated with the semi-automated forces; prototype high fidelity terrain database in an operational scenario; continue environmental representation research focused on dynamic environmental effects; dynamic terrain representation and weather effects; continue development of synthetic environment data bases to support the Synthetic Theater of War (STOW; 1997 exercise. ($9.0M)
- Continue development and demonstrate prototype synthetic forces architecture and creation of baseline software entities within that architecture capable of supporting a distributed virtual simulation of command entities. Develop and demonstrate increasingly more capable working Synthetic Forces representing a wider range of combat forces characterized by more accurate behavioral representation. ($19.8M)
- Continue development of a capability to support seamless land/sea/air warfighting simulation environment representing 15,000 entities operating with a high degree of realism, fully integrated and supporting service and joint operational concepts. ($14.2M)
- Continue development of a prototype, DIS based simulation architecture accommodating the evolution of advanced distributed simulation technology. ($2.0M)
- Initiate development of advanced simulation technologies to provide improved capability to the post STOW-97 synthetic environment. These include improved synthetic forces functionality; higher-level command entities; improved theater level functionality (e.g. logistics, electronic warfare, etc.); and deployable range instrumentation. ($15.4M)

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RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-37

- Design and develop components of an early entry command and control information systems environment capable of situational representations facilitating evaluations of battle management concept. ($7.6M)
- Continue development of concurrent engineering work stations and plan demonstration to assess adequacy of land vehicle design concepts. This is a demonstration of technology developed in PE 0602702E, TT-04. ($5.2M)

(U) FY 1996 Program:

- Continue to develop and demonstrate expanded information technologies supporting interaction of as many as 10,000 entities on the synthetic battlefield in a coordinated exercise, networking individual platform level simulators with company/battalion level synthetic forces. ($7.4M)
- Continue to develop and demonstrate a prototype environmental battlefield representation to include increased fidelity of terrain and environmental effects (e.g. fog, smoke, haze, diurnal effects, etc.); continue development of environmental data bases to support STOW 1997. ($6.3M)
- Continue development of synthetic forces command entities; expand development of synthetic forces to include representations of combat support and combat service support elements; continue to improve functionality of other synthetic forces. Develop and test a set of standard interface specifications capable of accommodating a variety of technical architectures which represent service unique command and operational features. ($20.3M)
- Continue development of simulation operating systems, testing and integration of technologies, and development of the ACTD legacy systems to support the STOW-97 ACTD. ($17.0M)
- Continue development of advanced simulation technologies to include improved synthetic forces functionality, higher level command entities, improved theater level functionality and deployable range instrumentation systems. ($17.0M)
- Expand development component of an early entry command and control information systems capable of situational representations facilitating evaluations of battle management concepts. ($6.9M)
- Demonstrate concurrent-engineering applications on land vehicle design, link to synthetic battlefield, and tie requirements to design. ($4.7M)

(U) FY 1997 Program:

- Design and test expanded information technologies supporting a wide range of LAN, MAN, WAN bandwidth demands created by the exercise of greater than 50,000 entities operating in a coherent, coordinated manner on the synthetic battlefield. ($1.5M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-37

- Continue to develop and demonstrate an environmental sub-architecture capable of supporting coordinated advanced distributed simulation exercises; continue development of environmental technologies capable of supporting a robust environmental battlefield to include interactive, fog haze, battlefield obscurant, diurnal effects; complete and transition STOW-1997 synthetic environment. ($5.0M)

- Continue to develop and transition a broad range of Synthetic Forces representing most combat elements as entity and small unit commanders, integrate with a simulation architecture supporting a distributed command and control structure portraying in simulation the influence of one command level on the actions of the subordinate formations. Continue to develop and demonstrate increasingly more sophisticated behaviors representing an extended set of battlefield reactions such as situational awareness, reaction to the environment and planning. ($11.7M)

- Demonstrate and transition to the ACTD a prototype Joint Synthetic Theater of War system supporting a seamless land/sea/air warfighting simulation environment capable of representing greater than 50,000 entities with a high degree of realism, supporting service and joint operational concept while retaining the arbitration of battle outcomes at the entity level of detail. ($8.5M)

- Continue development of advanced simulation technologies and deployable range instrumentation systems. Demonstrate those technologies which are sufficiently mature in STOW-97. ($10.0M)

- Demonstrate a concurrent engineering applications on land vehicle design, link to synthetic battlefield, and tie requirements to design. Integrate engineering applications with hardware test and evaluation tools and with the manufacturing modeling environment. ($7.9M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	59.2	79.3	76.9	40.7
Current Budget	58.0	78.3	79.6	44.6

(U) **Change Summary Explanation:**

FY 1994   Reduction of $1.2 million reflects minor repricings.
FY 1995   Reduction of $1.0 million reflects reprogramming to fund TRP earmarks.
FY 1996-97   Reflects outyear program adjustments to accommodate repricings.

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RDT&E, Defensewide	Experimental Evaluation of Major Innovative
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(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**

Milestones

Plan

Jul 94   Demonstrated second generation synthetic forces.

Nov 94   Demonstrated integration of live virtual and constructive forces in a joint warfighting simulation
at the entity level of detail working up to 3,500 entities. (Synthetic Theater of War - Europe
(STOW-E)).

Apr 95   Demonstrate prototype ADS Architecture.

Sep 95   Demonstrate command entity synthetic forces operating in a partially integrated environment with up
to 10,000 entities in perceptible real time.

Sep 95   Demonstrate working concurrent engineering toolbox for vehicle design.

Sep 96   Demonstrate higher level command entity synthetic forces operating in a more robust dynamic
environment.

Sep 96   Demonstrate the capability to support 50,000 entities in perceptible real time through dynamic
multicasting.

Nov 97   Demonstrate the STOW-97 ACTD synthetic theater of war capable of representing a JTF through
combination of live, virtual and constructive simulation with a high degree of realism and with
outcomes arbitrated at the entity level of detail.

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		DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E

COST *(In Thousands)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
UUV/Mine Countermeasures EE-39	23,850	18,839	16,950	17,570	17,395	18,115	21,115	26,115	Continuing	Continuing

(U) **Mission Description:** The increasing stockpile of underwater mines and the proliferation of weapons of mass destruction throughout the world present a threat in both littoral warfare and strategic warfare situations. The objective of this project is to develop and demonstrate fully autonomous maritime systems and technologies to counter this threat. Effort are focused in two areas: (1) Mine Countermeasures (MCM) and (2) enabling technologies for Unmanned Undersea Vehicles (UUV) and other taskable machines.

(U) In the MCM area, the Autonomous Minehunting and Mapping Technology (AMMT) Program is developing technologies in support of Navy clandestine mine warfare requirements that will enable the autonomous location and classification of mines with sufficient precision for detailed minefield mapping and subsequent reacquisition by a neutralization system. This capability will also be applicable for commercial undersea environmental survey and sampling.

(U) The project is also developing additional MCM technologies including a Synthetic Aperture Sonar (SAS) to increase search rate; small autonomous vehicles for mine countermeasures in the surf zone; and advanced acoustic communications that will enable tether-free control of minehunting UUVs. Enabling technologies being addressed include electromagnetic communications for use in shallow water, atomic interferometers for precision navigation, and a high energy density power system to provide the range and endurance required for longer UUV missions. These efforts are closely coordinated with the Navy's prioritized UUV acquisition programs promulgated in the FY 1994 Navy UUV Program Plan.

(U) **Program Accomplishments and Plans:**

(U) **FY 1994 Accomplishments:**

- Refurbished ARPA Unmanned Undersea Vehicle (UUV); conducted technical analyses. ($2.2M)
- Investigated technologies for maritime counterproliferation. ($.1M)
- Continued development of Autonomous Minehunting and Mapping Technology (AMMT) and small taskable machines. ($4.5M)
- Investigated Synthetic Aperture Sonar (SAS) minehunting technology. ($.1M)

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-39

- Conducted at-sea multi-sensor data collection and validated software design; developed multi-node acoustic communication network. ($1.8M)
- Conducted at-sea test with testbed magnetic communication system. ($.3M)
- Completed bench testing of Proton Exchange Membrane (PEM) fuel cell power plant; completed design and started construction of aluminum-oxygen fuel cell power plant. ($3.3M)
- Continued development of atomic interferometer inertial sensor. ($.2M)
- Developed molten carbonate fuel cells and 200kW phosphoric acid fuel cell system. Investigated technologies for logistic fuel, high performance PEM and solid oxide fuel cells. ($11.4M)

(U) FY 1995 Program:

- Configure UUV for at-sea testing; conduct modeling/simulation analysis. ($3.5M)
- Investigate application of electro-magnetic pulse technology and other technologies for special operations and operations other than war. ($0.1M)
- Continue AMMT development; prepare for Phase I at-sea demonstration of mine detection, classification, identification and mapping; test small taskable machines and modes of locomotion. ($8.3M)
- Develop SAS algorithms and models to increase minehunting area search rates. Conduct proof-of-principle demonstration. ($2.7M)
- Continue high energy density power system program. Construct and demonstrate aluminum-oxygen fuel cell power plant on land and prepare for at-sea testing in a UUV. ($2.7M)
- Continue advanced acoustic communications development. Demonstrate increased range and data rate. Integrate with AMMT. ($1.0M)
- Conduct at-sea test of prototype magnetic communication system. ($.2M)
- Continue development of atomic interferometer inertial sensor. ($.3M)

(U) FY 1996 Program:

- Examine concepts for maritime counterproliferation, including tagging of vessels carrying weapons of mass destruction. ($.7M)
- Integrate aluminum-oxygen fuel cell into an Unmanned Undersea Vehicle (UUV); conduct modeling/simulation. ($3.0M)
- Investigate technologies for mine neutralization by autonomous vehicles. ($.6M)
- Complete Phase I at-sea testing of Autonomous Minehunting and Mapping Technology (AMMT). Conduct Phase II development of adaptive vehicle and sensor control of integration of the environmental data collection package for at-sea testing; continue testing of small taskable machines. ($6.0M)

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major Innovative
Technologies, PE 0603226E, Project EE-39

- Continue development of advanced acoustic communications, including low probability of intercept communications. ($.3M)
- Continue development of synthetic aperture sonar (SAS) for minehunting. ($3.4M)
- Continue high energy density power system program. Commence at-sea testing of an aluminum-oxygen fuel cell in an UUV. ($2.8M)
- Test brassboard atomic interferometer inertial sensor. ($.2M)

(U) FY 1997 Program:
- Continue maintenance of ARPA UUV; integrate technology improvements; prepare for at-sea testing. ($2.7M)
- Continue development of stealthy special operations forces delivery vehicles. ($1.3M)
- Conduct Phase II at-sea testing of AMMT. ($6.6M)
- Test prototype SAS concurrent with AMMT at-sea testing. ($2.3M)
- Develop prototype small taskable machine for minehunting and mine neutralization in very shallow water and the surf zone and other applications. ($1.2M)
- Continue testing of long endurance aluminum-oxygen fuel cell at-sea. ($.9M)
- Continue development of advanced acoustic communications in support of Phase II AMMT at-sea testing. ($0.3M)
- Develop an unmanned undersea tag delivery vehicle for use in restricted waters, including harbors. ($2.3M)
- Develop an unmanned undersea tag delivery vehicle for use in restricted waters, including harbors. ($2.3M)

(U) **Program Change Summary:** (In Millions)

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	23.9	17.8	17.9	17.6
Current Budget	23.9	18.8	17.0	17.6

(U) **Change Summary Explanation:**

FY 1995 Increase of $1.0 million supports increased emphasis on the synthetic aperture sonar (SAS) program.
FY 1996 Reduction of $.9 million reflects minor repricing.

(U) **Other Program Funding Summary Cost:** N/A

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DATE	September 1994

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major Innovative
Technologies, PE 0603226E, Project EE-39

(U) **Schedule Profile:**

Plan   **Milestones**

Aug 94   Completed Proton Exchange Membrane (PEM) fuel cell power plant test.
Mar 95   Complete Phase I of Magnetic Communications Program.
May 95   Demonstrate acoustic communications network.
Oct 95   Begin Autonomous Minefield Mapping Technology (AMMT) Phase I at-sea testing.
Mar 96   Begin at-sea testing of integrated Unmanned Undersea Vehicle (UUV) aluminum-oxygen fuel cell
         power system.
May 96   Demonstrate small autonomous prototype legged taskable machine in surf environment.
Sep 96   Demonstrate prototype atomic interferometer inertial sensor.
Jul 97   Begin AMMT Phase II at-sea testing.
Sep 97   Begin synthetic aperture sonar at-sea testing.
May 98   Conduct test of small autonomous taskable machine with mine neutralization package.
Jul 98   Demonstrate autonomous tag delivery system Q.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies PE 0603226E

COST *(In Millions)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Critical Mobile Targets (WAR BREAKER) EE-40	117,424	122,639	132,146	123,552	121,887	132,360	137,360	146,360	Continuing	Continuing

(U) **Mission Description:** Prosecution of time-critical fixed and mobile targets has long been a concern of the Services as evidenced by past efforts in the areas of Strategic Relocatable Targets and Smart Weapons. Our experience in Desert Storm has dramatically demonstrated our current inability to prosecute these targets, particularly Tactical Ballistic Missile (TBM) launchers. ARPA's WAR BREAKER program will develop advanced technology and systems to enable the detection, identification and prosecution of a wide range of high value, time-critical fixed and mobile targets including TBM launchers, mobile command posts, Mobile Air Defense Units, tanks and artillery. This project serves as the framework for maturing and integrating advanced technologies, as well as developing and demonstrating systems concepts supporting the prosecution of these targets. Key technology areas include advanced surveillance, target acquisition, advanced automatic target detection and recognition, automated intelligence correlation, battlefield management, information distribution, terrain data generation technologies, advanced high throughput sensor processing, multi-sensor fusion, data fusion, image understanding, text understanding and sensor component technologies. Of these, the Intelligence and Planning component of WAR BREAKER is comprised of: Intelligence Correlation (IC), Multiple Access Intelligence and Nomination System (MAINS), Local Attack Controller (LAC), Terrain and Feature Generation (TFG), Internetted Unattended Ground Sensors (IUGS), and TOPSIGHT.

(U) **Program Accomplishments and Plans:**

(U) **FY 1994 Accomplishments:**

- Continued development of the WAR BREAKER analysis tool set to support Systems Engineering and Evaluation of systems performance within the Theater of Battle. Completed development of prototype baseline tool known as SimCore and started development of encapsulated SimCore Release 1. ($20.9M)

- Continued development of the Intelligence Correlation (IC) components/systems which extract, correlate, fuse and display intelligence information to determine changes in force status, order of battle and operational doctrine of time critical targets. ($13.5M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-40

- Initiated development of dynamic intelligence processor, tracking and battle management functions for the Local Attack Controller (LAC). Demonstrated initial capabilities in Army Deep Operations and Joint STARS (JSTARS) environments. ($7.5M)

- Demonstrated technology to rapidly access historical intelligence information from multiple heterogeneous databases (MAINS). Initiated development of mission nomination, distributed database and fusion technologies. Conducted User Test Assessments of Imagery Exploitation System enhancement of completeness, correctness and speed. ($8.4M)

- Initiated the design and development of the Terrain and Feature Generation (TFG) system. Developed algorithms for multi-spectral, IFSAR, optical and infrared sensor data processing for automatic feature extraction. Developed control and database structures for cartographic data fusion. ($1.6M)

- Applied advanced processing/processors to National Technical Means exploitation (TOPSIGHT). ($4.5M)

- Initiated Internetted Unattended Ground Sensors (IUGS) through awards of enabling technologies studies. ($6.0M)

- Conducted initial tests of three dimensional (3-D) Digital Terrain Elevation (DTE) Interferometric SAR (IFSAR) which includes provisions of mapping and terrain analysis data to the state of California. ($11.5M)

- Conducted Multi-Sensor Target Recognition System (MUSTRS) captive flight test on a helicopter to evaluate performace envelope limits. ($9.2M)

- Continued Automatic Target Detection/Recognition (ATD/R) technology development and assessment of potential target discriminants for prosecution of deep hide targets and initiated advanced Moving Target Indicator/Synthetic Aperture Radar (MTI/SAR) ATD/R algorithm tests. ($7.2M)

- Awarded contract(s) to evaluate enabling technologies to support Low Cost Synthetic Aperature Radar (SAR) production. ($10.6M)

- Analyzed and assessed the performance of algorithms in detecting manmade targets in foliage from imaging radar and Ultra-Wideband (UWB) SAR data. ($6.5M)

- Award contract for Gamma-Gamma resonance imaging development. ($4.9M)

- Completed current multispectral Electro-optical/infrared (EO/IR) and low-cost focal plane array technologies efforts. ($5.1M)

(U) FX 1995 Planned Program:

- Continue systems engineering analytical and distributed simulation exercises in support of the War Breaker system concept. Initiate analysis and modeling plan of two nearly simultaneous Major Regional Contingencies (MRCs). Complete encapsulated SimCore Release 1 for incorporation into analytical tool set. ($16.7M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE
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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-40

- Continue development, test, integration and demonstration of Intelligence Correlation (IC) technologies, components and systems to include a natural language processor, force/target tracker, force status assessor, and integration of two single intelligence correlators and a multiple intelligence correlator. ($17.5M)

- Continue development, test and integration of Local Attack Controller (LAC) components. Demonstrate initial integration of dynamic intelligence processor and battle management decision aids in an Air Force (CTAPS) environment. ($13.1M)

- Continue development, test and begin integration of the Multiple Access Intelligence and Nomination System (MAINS) to include demonstration of integrated query/fusion technologies and a mission nominator. ($10.2M)

- Complete software development and integration of the Imagery Exploitation System (IES). Conduct demonstration, test, and evaluation of the automatic processing of multiple sensors and context to detect and classify units. ($2.5M)

- Initiate development, test and integration of the Terrain and Feature Generation (TFG) system by competitive award. Integrate technologies into TFG testbed for end-to-end evaluation, database development and user assessment. ($6.3M)

- Continue to apply advanced fusion and vision algorithms on high performance processors for National Technical Means exploitation (TOPSIGHT). Integrate search and automatic target recognition capabilities. ($8.9M)

- Continue development and evaluation of enabling technologies for the Internetted Unattended Ground Sensors (IUGS). Examine additional technologies for performing precision air delivery and data fusion. ($4.7M)

- Continue technologies to provide rapid three-dimensional (3-D) digital terrain elevation data using interferometric SAR (IFSAR) and initiate transition to civilian sector. ($4.8M)

- Complete test and evaluation of Multi-Sensor Target Recognition System (MUSTRS) Technology. ($4.1M)

- Develop technology components for Automatic Target Detection and Recognition (ATR/D), target classification, based on Moving and Stationary Target Acquisition and Recognition (MSTAR) model-based reasoning approach program focused on SAR with applications to ladar and multispectral. ($9.0M)

- Continue Dragnet application development for detecting, recognizing and tracking high-value moving targets while they are actively moving in traffic, thus avoiding the cost of many high revisit rate SAR-imaging platforms. ($5.5M)

- Continue development of the Monitor application for aggregating vast quantities of imagery via change detection, medium/high resolution group reasoning and image super-resolution in order to efficiently generate synoptic views of the battlefield, substantially reducing the cost of the human analytic infrastructure and effecting a low cost radar. ($4.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-40	September 1994

- Continue Clipping Service capability to crop high-information content portions of images in order to reduce datalink throughput rates, to avoid dramatic data communications system costs and effect a low cost radar. ($2.7M)

- Continue the Affordable Radar program for reducing costs associated with surveillance Synthetic Aperture Radar (SAR) and other radars through use of commom production components. Initiate detailed design and experimentation contract(s). ($8.8M)

- Continue data analysis and assessment of the performance of advanced algorithms for detecting targets in foliage from high-resolution high frequency/ultrahigh frequency (HF/UHF) ultra-wideband foliage penetrating (FOPEN) Synthetic Aperture Radar (SAR) data. ($2.5M)

- Conduct end-to-end demonstration of the 'Expose' algorithm for FOPEN integrated components. ($1.3M)

(U) **FY 1996 Planned Program:**

- Conduct distributed simulation analysis and modeling of two nearly simultaneous Major Regional Contingencies (MRCs) incorporating current Services' capabilities along with Services' new developed systems, and ARPA's new development Surveillance & Targeting and Intelligence & Planning systems. ($15.7M)

- Continue development, test, integration and demonstration of Intelligence Correlation (IC) technologies, components, and systems. Initiate integration of the natural language processor with intelligence correlators, and the target tracker with the force status assessor. ($21.0M)

- Continue development, test and integration of Local Attack Controller (LAC) components. Demonstrate LAC prototypes in Army (Deep Operations), Air Force (CTAPS) and Airborne (JSTARS) environments. ($12.5M)

- Continue development, test and integration of the Multiple Access Intelligence and Nomination System (MAINS). Demonstrate query/fusion integration, "Cold Start" database build, distributed database and mission nomination capabilities. ($9.1M)

- Continue development, test and integration of the Terrain and Feature Generator (TFG) system for rapid processing of spatial data. Continue testbed technology insertion and evaluation. ($5.1M)

- Continue to apply advanced fusion and vision algorithms on high performance processors for National Technical Means exploitation (TOPSIGHT). Demonstrate initial integrated, cross-sensor search and automatic target recognition capabilities in a laboratory environment. ($8.2M)

- Demonstrate Internetted Unattended Ground Sensors (IUGS) component technologies to determine the performance gains in target classification and identification and the potential for an internetted system. ($5.2M)

- Continue development and evaluation of the best design/functionality of the interferometric SAR (IFSAR) for transition to military use. Complete IFSAR support of Korean operations. ($6.1M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-40

- Continue the development of 'Moving and Stationary Target Acquisition and Recognition (MSTAR(ATR/D) infrastructure and baseline algorithm suite and increase the number of targets modeled to 20. ($12.7M)
- Complete algorithm development and hardware modifications for the Dragnet application demonstration. ($5.0M)
- Continue developing Monitor application baseline configuration, including developing a testbed in cooperation with the ARPA Intelligence and Planning TOPSIGHT program. ($7.7M)
- Continue development of the Clipping Service application in cooperation with the DARO HAE UAV program. ($4.0M)
- Continue design of low-cost integrated radar product line under Affordable Radar Production Program. ($14.8M)
- Continue assessment of Expose capabilities consistent with Foliage Pentration (FOPEN) objective and complete characterization of FOPEN environment and predicted system performance. ($5.0M)

(U) FY 1997 Planned Program:

- Continue to conduct distributed simulation analysis and modeling of two nearly simultanious Major Regional Contingencies with current Services' capabilities, Services' new developed systems, and ARPA's new development Surveillance & Targeting and Intelligence & Planning systems. ($14.3M)
- Continue to develop, test, integrate and demonstrate Intelligence Correlation (IC) technologies, components, and systems. Demonstrate an initial fully integrated prototype in a laboratory environment. ($19.3M)
- Continue development, test and integration of Local Attack Controller (LAC) components and integrated prototypes. Integrate distributed database technologies from MAINS. Demonstrate initial integrated prototypes in multiple heterogeneous operational environments. ($10.7M)
- Continue development, test and integration of the Multiple Access Intelligence and Nomination System (MAINS). Demonstrate an initial integrated prototype in an operational environment. ($8.4M)
- Continue development, test, and integration of the Terrain and Feature Generator (TFG) system. Demonstrate an integrated initial prototype in an operational environment. ($4.9M)
- Continue to apply advanced fusion and vision algorithms on high performance processors for National Technical Means exploitation (TOPSIGHT). Demonstrate advanced integrated, cross-sensor search and automatic target recognition capabilities in a laboratory environment. ($7.9M)
- Begin integration of Internetted Unattended Ground Sensor (IUGS) component technologies, refine algorithmic approaches to signal processing and data fusion. Initiate fabrication of prototype sensor systems for future field testing. ($5.0M)
- Continue to develop the interferometric SAR (IFSAR) for inexpensive and accurate topography to support both civilian and military applications. ($3.5M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-40	DATE September 1994

- Evolve interferometric Synthetic Aperture Radar (IFSAR) fundamental technology base and intiate 'Mapper' capability to produce terrain elevation data using airborne and National assets. ($3.5M)
- Demonstrate Moving and Stationary Target Acquisition and Recognition (MSTAR(ATR/D) final configuration of algorithms suite and transition components. ($13.4M)
- Demonstrate Dragnet application as part of broad cost avoidance strategy for wide-area radar surveillance systems. ($3.5M)
- Continue Monitor application performance assessment in cooperation with the ARPA TOPSIGHT program. ($4.1M)
- Demonstrate Clipping Service system for screening SAR imagery. ($1.3M)
- Assess and select Affordable Radar Production integration contractor. ($16.8M)
- Demonstrate the Expose application for the Foliage Penatration (FOPEN) integrated airborne system. ($6.1M)
- Transition MSTAR(ATD/R) results to effect an Auxillary Sensor capability utilizing passive and/or active multispectral and ladar sensors. ($.8M)

(U) **Program Change Summary:**

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	117.2	132.9	148.4	152.5
Current Budget	117.2	122.6	132.1	123.5

(U) **Change Summary Explanation:**

FY 1995   Adjustments reflect reprogramming to fund Tier 3- and TRP earmarks.
FY 1996-97 Adjustments reflect offsets to satisfy directed POM/PDM requirements

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**

Plan
Milestones
Jun 94   Completed first phase of Multi-sensor Target Recognition System (MUSTRS) flight experiment (Helicopter).

Jun 95   Complete WAR BREAKER SIMCOR analysis/distributed simulation tool set.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE
September 1994

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E, EE-40

Nov 95 Demonstrate automapping capability using interferometric Synthetic Aperture Radar (IFSAR).

Nov 95 Initial demonstration of automatic cue development from contextual analysis of Moving Target Indicator (MTI) radar data.

Nov 97 Demonstrate technology to build and distribute over a wide area network, terrain, feature, intelligence, and object data for a 1 million square KM theater.

Nov 97 Demonstrate integrated intelligence correlation and battle management to facilitate local attack control.

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of
Major Innovative Technologies,
PE 0603226E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Air Defense Initiative EE-41	24,642	38,642	43,770	45,036	55,029	55,989	66,989	89,989	Continuing	Continuing

(U) **Mission Description:** Air Defense Initiative programs form a critical part of the Advanced Research Project Agency's program to ensure defense against cruise missiles and manned aircraft. The programs also complement systems being pursued by other program offices to counter theater ballistic missile threats. The rapid evolution and proliferation of cruise missile systems and technologies require new approaches and technologies to ensure effective and efficient countering of future air breathing threats to troops in regional theaters.

(U) The Mountaintop Program's objective is to accelerate the deployment of adaptive processing technology into DoD systems through: 1) enhanced understanding of phenomenology: 2) effective development of concepts; 3) practical systems applications; and 4) synergism with the adaptive processing community. Adaptive processing enables better detection, tracking, and engagement of faint targets despite harsh interference from natural and man-made sources; cost savings associated with tolerant sensors; and wider mission applications for individual sensors.

(U) HAVE DUNGEON is providing enhanced data integration and identification techniques to expand aerospace defense capabilities. Advanced hardware and software is being developed to exploit data provided by intelligence sensors and collateral surveillance systems to provide near-real-time warning, attack assessment, and track history for the engagement of hostile targets.

(U) The Simulation and Modeling Program investigates and demonstrates new air defense technologies and concepts, and their integration into theater force structure. It emphasizes and illustrates concepts to counter the cruise missile and other air breathing threats; and allows warfighters to test and demonstrate technology concepts. The program interacts with the existing Air Force Theater Air Command and Control Simulator Facility and the Navy Weapons and Tactics Analyses Center for man-in-the-loop simulation exercises. The initial simulation environment will be extended through ARPA's WAR BREAKER Defense Distributed Simulation System.

(U) The Special Materials Analysis program is investigating a new class of absorption materials developed from coated microballoons to determine their effectiveness and utility for a broad spectrum of applications.

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		DATE September 1994

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of
Major Innovative Technologies,
PE 060326E, Project EE-41

(U)   The Airborne Infrared Measurement System (AIRMS) program will provide improved scientific understanding of the fundamental limits of infrared technologies and will develop analytical tools, models and design methodologies, and associated signal processing algorithms and architectures. The program employs the existing AIRMS testbed airborne infrared imaging sensor and aircraft to collect high resolution digital imagery of airborne vehicles, background clutter, clouds, and other phenomenology.

(U)   The Advanced Fire Control program has been established to study and develop centralized fire control concepts to counter advanced air-breathing and tactical ballistic missile threats. This program will develop advanced airborne radar systems and demonstrate their effectiveness in flight tests against advanced threats. The program stresses how advanced fire control systems can enhance air defenses when made a part of a tightly integrated network. The program will develop or demonstrate effective timelines, handover and communications techniques among air defense assets in the integrated network.

(U)   **Program Accomplishments and Plans:**

(U)   FY 1994 Accomplishments:

- The Mountain Top program collected and analyzed a multi-channel radar database that emulates data from an airborne surveillance radar. This database was and continues to be distributed to the user community for the development and evaluation of advanced adaptive processing techniques. The program also characterized the radar cross-sections of tactical ballistic missiles and their plumes. This information will be used to study the capability of airborne sensors to counter the TBM threat. Studies and analyses were conducted for a joint surveillance Space-Time Adaptive Processing (STAP) processor meeting the needs of the Navy, Air Force, Army and advanced joint applications. ($14.6M)

- HAVE DUNGEON's Proof-of-Concept Aerospace Defense Location participated in an interactive Theater Missile Defense wargame with Air Force and Navy simulation facilities, and demonstrated the integration of overhead and undersea surveillance. ($3.0M)

- The Simulation and Modeling Program developed a prototype system supporting both analyses and man-in-the-loop exercises. ($5.1M)

- The Special Materials Analysis program continued investigation of the microballoon absorbing materials, ensure strict materials processing controls, and perform specific comparisons of these new materials with existing absorbers. ($1.9M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-41

(U) **FY 1995 Program:**

- The Mountain top Program will complete the move of its primary collection sensor to the Pacific Missile Range Facility (PMRF), Hawaii, and begin collecting multi-channel data of advanced, low-flying targets in over-water and littoral environments. Emphasis will be on studying the impact of jamming clutter and multipath on the detection of sea-skimming cruise missiles. The program will design an advanced adaptive processor using commercial off-the-shelf technology and having joint application of Space-Time Adaptive Processing (STAP) algorithms. The Centralized Research Environment for STAP Technology (CREST) will be hosted at a High Performance Computer Center. Programs will be initiated to: develop joint surveillance applications with the Navy, Air Force and Ballistic Missile Defense Organization, conduct advanced systems trade-off studies and critical experiments, expand the user community to include industry and academia, and investigate advanced phenomenology visualization. ($12.6M)

- HAVE DUNGEON will establish the utility of integrated intelligence and conventional data source integration in the tactical environment. ($2.0M)

- The Simulation and Modeling Program will complete incorporation of ADI models in the simulation system. Man-in-the-loop (MITL) exercises will address the value of new air defense technology concepts. ($10.0M)

- The Airborne Infrared Measurement System (AIRMS) will perform initial target data collection flights, and begin evaluation of operational algorithms for target detection and tracking. ($14.0M)

(U) **FY 1996 Program:**

- The advanced adaptive processor will be integrated into the Mountain top data collection sensor at PMRF for breadboard evaluation. The processor will be evaluated as an advanced joint processor. The CREST on-line data base and analysis tools hosted at the High Performance Computer Center will be upgraded for real time remote experimentation and follow-on joint trade-off testing with the PMRF collection sensor. Pilot projects for fire control, engagement and innovative sensors will be initiated. ($13.0M)

- The Simulation and Modeling Program will hold distributed exercises and demonstrations to verify performance of additional advanced sensor and netting to support Advanced Concept Technology Demonstration (ACTD) development concepts from EE-CLS/ADI program element. ($8.2M)

- The AIRMS will perform advanced target data collection flights, employ the data in the evaluation of algorithms, and perform near real time demonstrations with operational algorithms. ($4.3M)

- The Advanced Fire Control Radar (AFCR) program will conduct the initial series of check-out tests and will begin demonstration of performance against manned aircraft, cruise missiles, and tactical ballistic missiles. ($18.3M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-41

(U) **FY 1997 Program:**

- The Mountain top program will continue collecting and analyzing phenomenology and target data. The advanced, joint STAP processor will transition to the brassboard phase of development. The user data base and analysis tools will be coupled with the mountaintop hardware for user-in-the-loop investigations. Promising innovative sensors, fire control, engagement and dual-use applications will be pursued. ($14.6M)
- The Simulation and Modeling Program will provide ACTD concept models to distributed exercises to support MITL demonstration and test activities. ($7.2M)
- The AIRMS will demonstrate real time detection and tracking of airborne targets. ($3.2M)
- The AFCR program will continue with demonstration tests against advanced threats in an electronic countermeasure environment. ($20.0M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	24.6	38.6	25.6	25.0
Current Budget	24.6	38.4	43.8	45.0

(U) **Change Summary Explanation:**

FY 1995   Change is due to minor repricings.
FY 1996-97 The increase reflects transfer of the Advanced Fire Control Program from project EE-CLS.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:**

Plan   Milestones
Mountain Top Program:
FY 95/1 - Testing begins at the Pacific Missile Range Facility; Data base on-line at the Maui High Performance Computer Center (HPCC).
FY 95/1 - CREST on-line at HPCC.
FY 95/3 - User tools on-line at the Maui High Performance Computer Center.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
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FY 95/4 - Sensor participates in Navy Wide Area Defense Demonstration.
FY 95/4 - Sensor participates in Mountain Top Experiment.
FY 96/4 - Install STAP processor breadboard on sensor at PMRF.
FY 97/2 - Begin real time testing of clutter and jamming rejection techniques utilizing new processor.
FY 98/4 - Brassboard processor completed.

Simulation and Modeling Program:
FY 95/4 - Complete two additional simulation baseline models and the prototype system.
FY 96/4 - Conduct distributed Air Defense Initiative exercises demonstrating new concepts.
FY 97/3 - Apply prototype system to ACTD models to concept planning and development.

HAVE DUNGEON:
FY 95/3 - Prototype the system in exercise or operational demonstration.

Airborne Infrared Measurement System Program:
FY 95/4 - Perform the initial target data collection flights, and begin evaluation of operational algorithms for target characterization and recognition.
FY 96/3 - Perform advanced target data collection flights, employ the data in the algorithms, and perform near real time demonstrations with operational algorithms.
FY 97/1 - Demonstrate real time detection and tracking of airborne targets.

Advanced Fire Control Program:
FY 96/3 - AFCR system integration complete; initial system check-out tests; initiate demonstration tests against advanced threats.
FY 97/3 - Initiate demonstration tests to evaluate system performance against low-flying cruise missiles in an ECM environment.

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DATE September 1994

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Global Grid Communications EE-45	19,209	45,187	45,493	44,842	43,592	27,916	22,935	24,549	Continuing	Continuing

(U) **Mission Description:** This program develops and demonstrates advanced communications technologies needed for defense and intelligence operations for the 21st century. The program will develop advanced information processing concepts to support a geographically dispersed staff for crisis management. Services for an enhanced information infrastructure to support command and control will be developed and shown to be applicable to advanced, high performance (and commercially available) networks. This program will demonstrate that commercial communications resources and technologies can be integrated with advanced optical components developed in this program as well as DoD tactical and satellite technologies developed elsewhere. The key elements are:

(U) Applications such as intelligent decision aids, that enable a geographically distributed planning staff to develop and analyze a course of action.

(U) Advanced services such as scalable file systems, databases, and distributed computing support that are integrated with high performance computing, and free applications from the necessity to work down to the raw data transport level.

(U) Demonstration networks that validate the Research and Development and enable early application development and technology transition into DoD efforts such as Defense Information System Networks.

(U) Develop network controls pertaining to management, and security software technologies to enable sensor-to-shooter applications combining all network media.

(U) Develop advanced optoelectronic network component technology and network architecture for scalable and modular networks. The aggregate network bandwidth will be in the range of terabits per second and the network will handle Multi Media service for both digital and analog signals.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-45	September 1994

(U) **Program Accomplishments and Plans:**

(U) **FY 1994 Accomplishments:**

- Designed the software architecture and conducted initial tests for joint task force planning/execution including weather, intelligence, strike planning and logistics. ($10.7M)

- Initiated network management, control, signaling efforts and demonstrated interoperability between commercial and DoD network assets. ($4.9M)

- Initiated optoelectronic network component technology development: switch, multiplexer, filter, amplifier and synchronizer. ($3.6M)

(U) **FY 1995 Program:**

- Design and conduct initial assessments of information services for the defense internet; evaluate pototype software components in a software engineering testbed and during an operational exercise. ($18.4M)

- Utilizing planning and decision developed aids, support the rapid construction of multiple crisis action plans. ($3.5M)

- Integrate DoD and commercial networks and demonstrate services and network management in support of DoD experimental application with military attributes such as crypto surge capability. ($5.3M)

- Demonstrate advanced optical network capability and demonstrate multi-wavelength reconfigurable network architecture. ($18.0M)

(U) **FY 1996 Program:**

- Demonstrate evolving software development practices and the migration of software applications and information services to higher bandwidth networks in an operational exercise involving multiple JTFs. ($18.9M)

- Demonstrate integration on a CONUS/International scale of all networks and demonstrate end-to-end secure transmission and signaling at gigabit rates. ($5.0M)

- Demonstrate high bandwidth operation of critical multi-wavelength components. ($13.9M)

- Field test local area network application of multi-wavelength analog and digital signal transmission. ($7.7M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-45

(U) **FY 1997 Program:**

- Identify control and protocol issues for operation of multi-wavelength networks. ($3.9M)
- Demonstrate advance integrated optoelectronic network component operations. ($10.7M)
- Complete multi-wavelength network architecture and control planning; and initiate field-trial network deployment for long-distance and wide area applications. ($13.4M)
- Demonstrate integration with advanced optical testbeds; large scale planning demonstrations; and deployable JTF C3 (mobile C3, plan rehearsal and refinement during deployment, intelligent interfaces). ($16.8M)

(U) **Program Change Summary:**   *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	19.2	48.5	51.9	49.8
Current Budget	19.2	45.2	45.5	44.8

(U) **Change Summary Explanation:**

FY 1995   Adjustment to fund TIER III in Project EE-CLS.
FY 1996-97 Adjustments reflect PDM offsets.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**

Planned   Milestones

Apr 95   Demonstrate optical component prototypes.
Jul 95   Multiple crisis scenario (integrated simulation and modeling tools, more powerful trade-off analysis)
Sep 95   Integrate defense high performance networks with cross-country backbone using SONET/ATM. Early planning support demonstrations.
May 96   Demonstrate network combining crypto, commercial communications, and defense secure wireless, satellite.

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DATE
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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-45

May 97 Demonstrate integration with advanced optical testbeds. Large scale planning demonstrations.
Jul 97 Deployable JTF C3 (mobile C3, plan rehearsal and refinement during deployment, intelligent
interfaces).

May 98 Cross-country demonstration of optical and advanced network management.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE September 1994

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E

COST *(In Thousands)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Defense Simulation Internet (DSI) EE-46	31,617	17,355	27,700	37,390	0	0	0	0	0	N/A

(U) **Mission Description:** The goal of the Defense Simulation Internet (DSI) program is to research, develop and test at scale (worldwide), a network infrastructure capable of enabling distributed, real-time, multi-media (video, voice, shared data and work spaces) simulation that will seamlessly integrate all simulation and modeling functions from early design to battle rehearsal enroute to the conflict. In its current state, the DSI is a collection of individual technologies that must be matured into a communications system. The communications needs of the distributed, real-time, multi-media simulation community cannot be met with any available technology. Commercial vendors are pursuing some of the required technologies, but development is too slow to accommodate the immediacy of the Department of Defense's simulation requirements. The DSI program is therefore accelerating the commercial development of the technologies needed by the simulation community for distributed work environments worldwide. Nearly 100 nodes currently extend the DSI to each of the Services, most of the Commanders-in-Chief (CINCs) and other Government affiliated sites. These locations constitute the network's test sites; they provide valuable feedback on the technologies and methodologies being pursued.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Implemented interim upgrade to the network backbone (from 1.5 megabits per second (Mbps) to 6 Mbps) within the continental United States (CONUS), increasing bandwidth, throughput capacity and user capacity. Replaced current proprietary backbone with commercial-off-the-shelf (COTS) routers. ($2.9M)
- Upgraded the transatlantic and transpacific circuit capability to a T1 circuit (from .512 Mbps to 1.544 Mbps). Continued to lease current outside-CONUS (O-CONUS) circuits. ($2.4M)
- Continued to lease approximately 100 communications lines currently connecting the Defense Simulation Internet (DSI) sites to the network backbone and leased an additional 40 new lines for additional sites. (Collectively referred to as tail circuits.) ($5.3M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Experimental Evaluation of Major
BA 3 Advanced Development	Innovative Technologies,
	PE 0603226E, Project EE-46

- Continued to operate the Network Operations Center (NOC); and provided network engineering support, exercise engineering and onsite support worldwide, security management and oversight, user training and hotline support, network configuration management including inventory control, and network equipment maintenance. (Collectively referred to as Operations Support). Began design and implementation of the Consolidated NOC. Currently providing ongoing operations support to major activities, including the Korean Initiative, Synthetic Theatre of War Europe (STOW-E), and ULCHI Focus Lens exercise. ($10.9M)

- Initiated efforts for development of economical, multi-use, high speed, high capacity (bandwidth) communications supporting classified/unclassified traffic and engineer an unconstrained distributed simulation on the DSI network. Related efforts include support of bandwidth reduction technology, Defense Research Engineering Network (DREN) interface, evaluating available desktop video teleconferencing (VTC) capabilities, and exploring simulation applications for the proposed National Information Infrastructure (NII). ($3.7M)

- Developed enhancements to Stream 2 (ST2) Protocol in support of real-time, distributed, multi-media simulation requirements such as multi-casting, resource and network management, and implemented them on commercial-off-the-shelf (COTS) devices. ($3.5M)

- Initiated efforts to design and engineer a higher speed backbone to support the transition of the DSI into a cost-effective, high-performance services network, targeting frame relay and Asynchronous Transfer Mode (ATM) interfaces as key technologies. Began preliminary phase of evaluating high-speed, end-to-end encryption (E³) devices that are protocol independent. ($2.9M)

(U) FY 1995 Program:

- Implement upgrade to the network backbone to 45 Mbps (T3) within the CONUS. A T3 is the first phase of migration of the network to ATM and the most immediate task in upgrading the network in preparation for transition to a life cycle support agency. Procure and install new backbone routers/switches. Initiate, as required, the upgrade of the network backbone to 155 Mbps (OC3) within the CONUS. As the number of new sites moves rapidly upward by forty per year, and as all sites become more experienced in using the distributed features of the network, the backbone traffic is increasing exponentially. A T3 backbone will be inadequate for the DSI by FY96. An OC3 backbone within the CONUS, with multicasting and resource guarantee protocols in place, will be necessary for the DSI at least as early as FY96. This backbone upgrade will coincide with the insertion of ATM premise devices and the ATM E3 devices at user sites which will significantly increase their performance capabilities. ($6.0M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-46

Continue to lease CONUS, O-CONUS circuits, 140 tail circuits plus 40 new sites to be added annually to the network. It is anticipated that as newer technologies become available, the average cost of a Ti will decrease in CONUS. As the decrease in CONUS circuit costs occurs, additional capacity and upgrade will be purchased for the Pacific and Atlantic O-CONUS areas. ($5.9M)

Continue to provide operations and maintenance support using the Consolidated Network Operations Center (NOC). During the period of transition from the current DSI NOC to the consolidated NOC, network operations and maintenance must support all protocols; Internet Protocol (IP) and Stream 2 (ST2) Protocol, to the new ATM based DSI. User tools will be developed and brought online, decreasing cost and network operations complexity as the older system is transitioned into the new. ($3.6M)

Continue to support an l provide service to the user community by the Customer Service Center (CSC) through site deployment, technical assistance, training, and event/exercise planning and support. ($1.9M)

(U) FY 1996 Program:

Implement limited ATM Operations to support transition to full ATM Operations by 3Q FY96. ($7.0M)

Continue to lease CONUS, O-CONUS circuits, 180 tail circuits plus 40 new sites, and upgrade high use sites to higher lines speeds. ($10.3M)

Continue to provide operations support to include scheduling, training, maintenance, deployment services, exercise/event support. ($8.2M)

Continue to provide operations support using the Consolidated NOC. The NOC will support an ATM-based DSI network, at the premise and backbone. THE ATM-based DSI network is required to support advanced simulation requirements. ($2.2M)

(U) FY 1997 Program:

Continue to lease CONUS network backbone circuits, OCONUS circuits, 220 tail circuits plus 40 new sites. ($18.9M)

Continue to provide Operations Support. The operations objective is to maintain and operate the DSI in a manner consistent with the DSI user community requirements. Operations include the Network Operations Center (NOC), configuration control, circuit provisioning, network security, exercise/event engineering, exercise on-site support, exercise/event scheduling and coordination, equipment maintenance, and a 24-hour help desk. ($18.5M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-46

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	31.6	15.9	26.2	37.0
Current Budget	31.6	17.3	27.7	37.4

(U) **Change Summary Explanation:**

FY 1995-97 Increase reflects minor program repricing.

(U) **Other Program Funding Summary Cost:** N/A

(U) **Schedule Profile:**

Plan	Milestones
Feb 94	Doubled DSI Backbone capacity (3 Mbps).
May 94	Completed Interim Backbone upgrade (6 Mbps).
Jan 95	Complete T3 Backbone upgrade (45 Mbps).
Nov 95	Begin Hybrid (IP/ST/ATM-based) operations.
Jul 96	Complete OC3 Backbone upgrade (155 Mbps).
Sep 96	Complete transition to ATM operations.
Sep 97	Complete network transition to DISA.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Advanced Submarine Technology, PE 0603569E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Subtech AS-01	43,839	25,261	20,973	10,000	5,449	26,230	46,230	35,530	Continuing	Continuing

(U) **Mission Description:** The objectives of this project are to develop and demonstrate advanced concepts and to pursue critical enabling technologies for future ship classes. The evolving worldwide threat of quiet diesel submarines and the proliferation of sophisticated submarine and weapons capabilities available to third world countries necessitates that the U.S. continue to maintain a superior submarine force. U.S. submarine technologies must keep pace with changing threats and remain immune to technological surprises, but declining resource availability mandates that this be done affordably. Therefore, the main thrust of this project is to provide far-term solutions for both increasing ship affordability and enhancing our operating capabilities in the littorals.

(U) This project continues to develop and demonstrate innovative technologies initiated under hydrodynamic control, advanced materials/structures, and structural acoustics efforts to reduce ship observables. These technologies will significantly enhance submarine stealth and survivability. They form the basis for efforts addressing affordability through improvements in structural acoustic design capabilities, innovative machinery mounting systems, and high reliability propulsion systems. Under the thick section composites and embedded sensors efforts, the advanced structural fabrication processes and strength monitoring capabilities necessary to introduce affordable advanced lightweight structural materials into ship construction programs are being demonstrated.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Fabricated non-autoclave cure thermoplastic-stiffened composite cylinders, door and spheres; tested thermoplastic cylinder, thermoset door and thermoset sphere; continued development of material properties characterization tools and Non-Destructive Evaluation (NDE) methods. ($7.8M)
- Continued fabrication of SUPRELITE components for fatigue test. ($5.1M)
- Continued development of design and fabrication methodology for fiber placement cylinder and resin transfer molding (RTM) articles with embedded sensors. ($2.5M)
- Implemented automatic 3-D mesh generator for the Stealth Designer's Workbench (SDW). ($0.3M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE
September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Submarine Technology, PE 0603569E, Project AS-01

- Developed Active Structural Control (ASC) techniques for: a) shock attenuation and design of a concept demonstration system for Special Warfare Craft, b) suppression of blade resonance and resulting high cycle turbine fatigue failure, and c) active vibration isolation of electronics cabinets; and initiated concept demonstration system design. This effort was funded by a Congressional addition to the FY 1994 President's Budget. ($8.0M)

- Demonstrated feasibility of ASC chatter and vibration control for high speed, high precision machining operations. Formulated concepts for ASC of chatter in precision milling operations. ($2.0M)

- Demonstrated active sound isolation through magnetic levitation. ($3.4M)

- Completed 50:1 scale model tests and numerical simulations for hull response to lightweight structures and completed truss beam damping tests, design of truss attachment, and numerical simulations. ($6.0M)

- Fabricated and tested active smart skin and Electromagnetic Turbulence Control (EMTC) concepts. ($3.4M)

- Expanded on technology developed in thick composites program and initiated fabrication of one Dry Deck Shelter (DDS) and test vehicle. This effort was funded by a Congressional addition to the FY 1994 President's Budget. ($4.3M)

- Evaluated advanced stealth, signature control, communications, materials, and producibility technologies to enhance submarine performance in littoral warfare. ($1.0M)

(U) FY 1995 Program:

- Develop and test active shock attenuation techniques. Initiate design of a thermally-boosted acoustic source for stealth applications. ($2.5M)

- Conduct a full scale demonstration of ASC for turning and boring applications. Initiate feasibility demonstration of ASC concepts for high speed milling. Develop ASC grinding operations. ($1.1M)

- Demonstrate active compliant structure control concepts at laboratory scales. ($1.0M)

- Complete design and fabrication of 1/4-scale model for lightweight structures and complete truss testing and numerical simulations. ($5.0M)

- Continue fabrication, assembly and test of thick composites components and a cylinder with embedded sensors, and refinement of sensor demodulation and non-destructive evaluation (NDE) methods. ($6.4M)

- Develop large scale, curved surface application of Electromagnetic Turbulence Control (EMTC). ($4.0M)

- Conduct initial demonstration of individual submarine stealth and littoral warfare operational enhancing technologies. ($5.3M)

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	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Submarine Technology, PE 0603569E, Project AS-01

(U) **FY 1996 Program:**

- Demonstrate Active Structural Control (ASC) shock attenuation techniques on full-scale platform. Develop and test a demonstration system to validate the design of a thermally-boosted acoustic source for stealth applications. ($2.6M)

- Demonstrate full scale ASC of high speed milling applications. Initiate feasibility demonstration to validate ASC concepts for active control in high speed grinding. ($1.6M)

- Integrate truss and hull structure at 1/4-scale. ($4.2M)

- Complete fabrications assembly and installation of composite components and conduct at-sea test. ($1.9M)

- Conduct an at-sea demonstration of drag reduction, acoustic quieting and control using EMTC on a large scale vehicle. ($4.0M)

- Demonstrate feasibility of integrating littoral warfare mission enhancements and stealth technologies into concepts for enhancing submarine shallow depth operations. ($6.7M)

(U) **FY 1997 Program:**

- Demonstrate and validate 1/4-scale truss design. ($4.5M)

- Perform large scale demonstration of integrated stealth technologies, mission enhancements, and communications capabilities in submarine littoral warfare. ($5.5M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	44.2	25.3	19.5	24.3
Current Budget	43.8	25.3	21.0	10.0

(U) **Change Summary Explanation:**

FY 1994   Adjustment reflects minor repricing.

FY 1996   Increase in FY 1996 reflects reprioritization to permit demonstration of Electromagnetic Turbulence Control (EMTC).

FY 1997   Decrease reflects the transfer of funding related to the Mechanical Technology Initiative into the Naval Ship/Sensor Systems Project, PE 0603226E.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Submarine Technology, PE 0603569E, Project AS-01

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**

Plan

Milestones

Oct 94	Concept feasibility demonstration of precision machining turning and boring operations.
Nov 94	Concept feasibility demonstration of electronics cabinet vibration isolation system.
Dec 94	Concept feasibility demonstration of active shock attenuation system.
Dec 94	Demonstrate EMTC in a high speed water tunnel on a Mk48 torpedo for drag reduction and control authority.
Aug 95	Factory floor demonstration of precision machining turning and boring operations.
Sep 95	Concept feasibility demonstration of active control of turbine blade resonance vibrations.
Sep 95	Demonstrate feasibility of individual stealth technologies in submarine design concepts optimized for littoral operations.
Sep 95	Complete testing of optimized EMTC tiles in a high speed seawater environment.
Feb 96	Full-scale demonstration of active shock attenuation system.
Mar 96	Demonstrate EMTC at-sea on a full scale marine vehicle for acoustic quieting, drag reduction, and control authority.
Apr 96	Installation and initial at-sea test of full scale SUPRELITE rotor. Transition to Navy.
Jun 96	Complete testing of integrated 1/4-scale lightweight truss structures.
Jul 96	Concept feasibility demonstration of thermoacoustic source noise cancellation system.
Aug 96	Full-scale demonstration of active control of turbine blade resonance vibration.
Aug 96	Large-scale demonstration of mission enhancements and stealth technologies in submarine design concepts.
Sep 96	Factory floor demonstration of precision machining milling operation.
Jun 97	Full-scale demonstration of thermally boosted acoustic source for stealth applications.
Jul 97	Demonstration of Integrated Stealth Technologies for submarine concepts.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

		DATE: September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Defense Reinvestment, PE 0603570E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Defense Reinvestment PT	474,000	625,000	650,000	675,000	700,000	725,000	500,000	250,000	Continuing	Continuing

(U) **Mission Description:** The purpose of the Defense Reinvestment program is to stimulate development of technologies that will provide both new military capability and new commercial products, and further the integration of commercial and military production. Once developed and deployed, the resulting technologies will increase both national security and the national economy. The program's objective will be achieved through the application of defense and commercial resources to develop dual-use technologies, provide manufacturing and technology assistance to small firms, and establish education and training programs designed to enhance U.S. manufacturing skills and target displaced defense industry workers. The program consists of multiple projects generally grouped into the following categories.

  Defense Dual-Use Critical Technology Partnerships
  Commercial-Military Integration Partnerships
  Defense Advanced Manufacturing Technology Partnerships
  Manufacturing Engineering Education Grant Program
  Regional Technology Alliances
  Agile Manufacturing/Enterprise Integration Program
  Advanced Materials Synthesis and Processing Partnerships
  U.S.-Japan Management Training Program
  MARITECH
  Small Business Innovation Research

(U) The initial competition held in FY 1993/1994 resulted in the selection of 212 proposed partnerships. Lessons learned from this competition were shared with potential future partners through nationwide multi-city outreach seminars. These lessons are analyzed and applied, as appropriate, to enhance the program each year.

(U) The FY 1995 program will solicit proposals in a general competition with emphasis on developing dual-use technologies. Changes in authorization language will be implemented to provide additional assistance for small businesses. Manufacturing Education and Training and Regional Technology Alliances will remain a part of the program, but the manufacturing Extension programs will be reduced in scope. The Maritime Technology (MARITECH)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Defense Reinvestment, PE 0603570E

initiative, a program to help the U.S. shipbuilding industry to survive by facilitating its penetration of the international commercial shipbuilding industry has been incorporated into the Defense Reinvestment Program.

(U)   The FY 1996 and FY 1997 programs will continue to develop and deploy promising new technologies with competitions planned for each year.   The majority of the initial partnerships will have concluded their first phase by this time and studies will be initiated to analyze the success/results of these first efforts.   At a minimum, the studies will search for strengths/weaknesses of each partnership and an overall assessment on the progress of the program.

(U)   Funding for the Small Business Innovation Research (SBIR) Program is included within this Program Element to strengthen the role of small business in meeting dual-use research and development for both military and commercial applications.

(U)   **Program Accomplishments and Plans:**

(U)   FY 1994 Accomplishments:

- Funded highly successful proposals identified as part of the FY 1993 solicitation.   ($140.0M)
- Funded on-going manufacturing efforts such as the Agile Manufacturing program and the SBIR program. ($99.0M)
- Completed the selection process and identified new partnerships for a focused technology competition concentrating on 7 technology areas and deployment components.   ($150.0M)
- Announced an open, general solicitation to be conducted in early to mid FY 1995.   This competition will use remaining FY 1994 funds ($85.0M) as well as those appropriated in FY 1995.

(U)   FY 1995 Program:

- Sign agreements with partners selected under focused competition.
- Conduct out-reach seminars to assist potential partners in responding to general competition announced in FY 1994.
- Execute FY 1995 options on successful partnerships begun in FY 1993 and FY 1994.
- Select and establish new partnerships resulting from the general competition announced in late FY 1994.
- Sign agreements with partners selected under the general competition.
- Commence development of advanced shipbuilding, conversion, and repair process technologies to enhance the competitiveness of U.S. industry under the MARITECH program.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Defense Reinvestment, PE 0603570E

(U) **FY 1996 Program:**

- Initiate the FY 1996 competition.
- Execute FY 1996 options on partnerships begun in FY 1995 and prior.
- Conduct additional out-reach seminars to discuss lessons learned from previous competitions.
- Complete selection process and identify new partnerships.
- Conduct formal assessment of FY 1993 program results.
- Sign agreements with partners selected under the FY 1996 competition.
- Initiate full-scale U.S. shipyard implementation of advanced technologies for shipbuilding, conversion, and repair processes under the MARITECH program.

(U) **FY 1997 Program:**

- Initiate the FY 1997 competition.
- Execute FY 1997 options on partnerships begun in FY 1996 and prior.
- Conduct out-reach seminars to discuss lessons learned from previous competitions.
- Complete selection process and identify new partnerships.
- Conduct formal assessment of FY 1994 program results.
- Sign agreements with partners selected under the FY 1997 competition.
- Continue U.S. shipyard implementation of advanced shipbuilding, conversion, and repair process, technologies under the MARITECH program.

(U) **Program Change Summary:** (In Millions)

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	474.0	625.0	650.0	675.0
Current Budget	474.0	625.0	650.0	675.0

(U) **Change Summary Explanation:** No change.

(U) **Other Program Funding Summary Cost:** N/A

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 3 Advanced Development	Defense Reinvestment, PE 0603570E	September 1994

(U) **Schedule Profile:**

Plan

	Milestones
1st Qtr FY 95	Sign agreements with partners selected under focused competition.
3rd Qtr FY 95	Select and establish new partnerships identified during the general competition announced in late FY 1994.
1st Qtr FY 96	Initiate the FY 1996 competition.
1st Qtr FY 96	Initiate full-scale shipyard implementation of MARITECH.
1st Qtr FY 97	Initiate the FY 1997 competition.
4th Qtr FY 98	Complete shipyard implementation of MARITECH.

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Electronics Manufacturing Technology, PE 0603739E

COST *(In Thousands)*	EY 1994	EY 1995	EY 1996	EY 1997	EY 1998	EY 1999	EY 2000	EY 2001	Cost to Complete	Total Cost
Electronics Manufacturing Technology	377,551	342,129	375,520	404,550	408,810	384,869	441,081	483,946	Continuing	Continuing
Microelectronics Manufacturing MT-01	0	0	4,000	48,646	46,800	65,250	70,550	73,900	Continuing	Continuing
(MIMIC) MT-02	79,631	22,274	0	0	0	0	0	0	0	N/A
IR Focal Plane Array (IRFPA) MT-03	41,429	44,809	37,661	19,400	0	0	0	0	0	N/A
Electronic Module Technology MT-04	115,274	128,325	156,812	141,823	152,089	161,872	207,564	231,534	Continuing	Continuing
Tactical Display Systems MT-05	9,263	15,030	25,801	23,169	29,735	27,546	30,500	40,500	Continuing	Continuing
Microwave and Analog Front End Technology (MAFET) MT-06	0	24,169	28,399	33,133	54,981	55,201	62,467	68,012	Continuing	Continuing
Centers of Excellence MT-07	23,837	23,000	14,000	10,000	0	0	0	0	0	N/A
Manufacturing Technology Initiative MT-08	7,186	14,342	27,800	29,112	35,920	25,000	25,000	25,000	0	N/A
Dual Design/Manufacturing Technology MT-09	0	20,180	21,335	22,467	8,985	0	0	0	0	N/A
Advanced Lithography MT-10	57,931	10,000	40,000	61,800	65,300	50,000	45,000	45,000	Continuing	Continuing
Computer-aided Acquisition and Logistics Support MT-11	43,000	40,000	19,712	15,000	15,000	0	0	0	0	N/A

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E	September 1994

(U) **Mission Description:** The Electronics Manufacturing Technology program element is budgeted in the Advanced Development Budget Activity because it seeks to design and demonstrate state-of-the-art manufacturing and process technologies for the production of various electronics and microelectronic devices, sensor systems, actuators, gear drives that have both commercial and military applications. Introduction of advanced product design capability and flexible, scalable manufacturing techniques will enable the commercial sector to rapidly and cost-effectively satisfy military requirements and enhance the U.S. industrial base.

(U) The objective of the Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC) project is to accelerate the development, manufacturing and demonstration of affordable microwave and millimeter wave analog integrated circuits. This technology will be the basis for the efforts in the Microwave and Analog Front End Technology (MAFET) program (MT-06) beginning in FY 1995. The MAFET program will further enhance microwave and millimeter wave module performance at reduced costs.

(U) The IR Focal Plane Array project focuses on the establishment of a manufacturing base for advanced infrared sensor arrays for major weapons systems. This base will allow the systems to meet operating requirements at approximately 1% of the current cost.

(U) The goal of the Electronic Module Technology project is to allow for the timely insertion and rapid acquisition of state-of-the-art microsensors and actuators, conformal electronics and affordable, high performance application specific electronic module (ASEM), components into major military systems. These systems include automatic target recognition, electronic counter-measures and Signal Intelligence (SIGINT). This project includes Advanced Technology Demonstrations in ASEM and Rapid Prototyping of Application Specific Signal Processor.(U) Tactical Display Systems projects develop and demonstrate high definition miniature displays to provide visual information to individual combatants and small groups who are remotely located from conventional visual information sources.

(U) The Centers of Excellence program finances demonstration, deployment of and training on advanced manufacturing technologies. The goal of this technology is to reduce unit and life-cycle costs while improving quality.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Electronics Manufacturing Technology, PE 0603739E

(U)   The goal of the Manufacturing Technology Initiatives program is to reduce the cost and acquisition leadtime of future military systems by integrating manufacturing process considerations during the product design phase, and by demonstrating high efficiency multi-product prototype factories. The project funds two Advanced Technology Demonstrations, the Active Electronically Scanned Arrays program and the Flexible Design and Assembly of Missile and Munitions Seekers program, to provide practical examples of these concepts.

(U)   The Dual-Use Design and Manufacturing project will enable manufacturers to economically produce military variants of their commercial products in limited quantities through the introduction of flexible process technologies. Key concepts that are integral to dual-use manufacturing capability such as advanced design systems scalable components and subsystems, flexible factory systems, and improved manufacturing operations control will be demonstrated in two sub-projects: the Interferometric Fiber Optics Gyroscopes and Manufacturing Systems Technology Electric Drive System projects.

(U)   Advanced Lithography technology has enabled the dramatic growth of integrated circuit capability. Advances have led directly to improvements in electronic and computing systems performance in terms of speed, power, weight and reliability.

(U)   The goal of the Computer-aided Acquisition and Logistic Support initiative is to transition DoD's current paper intensive weapon system support processes to a highly automated and integrated mode of operation. The transition will result in a fundamental change in the way DoD and industry use and distribute technical information, improving the quality and productivity of weapon system development and support.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Microelectronics Manufacturing Technology MT-01	0	0	4,000	48,646	46,800	65,250	70,550	73,900	Continuing	Continuing

(U) **Mission Description:** Microelectronics manufacturing is tightly tied to the development of highly sophisticated, specialized equipment. This program will concentrate on supporting equipment development for the .18 micron penetration of semiconductor technology. Furthermore, the capability to manufacture differentiated integrated circuits (ICs) -- i.e., logic, application-specific ICs, microprocessors -- at the state of the art and in any volume with rapid turnaround is vital to the creation of leading-edge information systems for defense. One focus of this project is on the manufacturing tools and methodologies needed for low-cost, flexible, environmentally safe, contamination-free manufacturing to meet Defense needs. Today's microelectronics manufacturing technology is optimized to produce a single part type in large volumes. This project will combine advances in physical equipment (modular cluster tools with real-time model-based process control, ultra-clean infrastructure, and cost-effective lithography) with software advances (fully integrated computer-integrated manufacturing (CIM) systems and modeling and simulation tools for designing processes, tools, and factories) to enable state-of-the-art microelectronics manufacturing facilities capable of producing many part types in any volume at low cost.

(U) **Program Accomplishments and Plans:**

(U) **FY 1994 Accomplishments: N/A**

(U) **FY 1995 Program: N/A**

(U) **FY 1996 Program:**

* Initiate effort to synthesis active chemical compounds for use in contamination-free manufacturing at the point where they are to be used rather than stored at a remote site. ($4.0M)

(U) **FY 1997 Program:**

* Initiate development of key equipments and unit processes to enable volume independent 0.18 micron semiconductor manufacturing. ($15.0M)
* Development environmentally safe manufacturing processes. ($7.0M)
* Continue point-of-use chemistry and distribution for contamination-free manufacturing. ($5.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-01

- Initiate development and integration of a set of software tools that support process programmability, and first-pass success manufacturing. ($8.0M)
- Initiate demonstration of factory technology for automated production, including advanced process control. ($13.6M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	0	0	3.0	11.5
Current Budget	0	0	4.0	48.6

(U) **Change Summary Explanation:**

FY 1996 Repriced to provide adequate funds for program initiation.
FY 1997 Revised to support the development of manufacturing tools for state-of-the-art and volume independent manufacturing of cost effective components for DoD specific applications.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**

Plan   Milestones
Jul 97 Develop process and manufacturing tool strategies for scaleable manufacturing of state-of-the-art components for DoD specific applications.
Dec 97 Demonstrate unit processes incorporating scaleable manufacturing tools for DoD specific applications.

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	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Electronics Manufacturing Technology PE 0603739E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
MIMIC MT-02	79,631	22,274	0	0	0	0	0	0	0	N/A

(U) **Mission Description:** This project provides for the acceleration of development, manufacturing and demonstration of affordable microwave and millimeter wave analog integrated circuits (ICs). The Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC) program is providing previously unavailable microwave and millimeter-wave integrated circuits to enable DoD systems to meet size, weight and power constraints at the lowest possible cost. Its primary thrust is to develop affordable circuits operating in the 1 to 100 GHz frequency range with required characteristics and sufficient quantity to satisfy military systems needs. The use of reliable and maintainable semiconductor devices and circuits for selected system demonstrations will be accelerated and, thus provide the United States with a technological lead in deploying MIMIC-based military systems.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Continued work on MIMIC Phase 2 contracts including delivery of process demonstration wafers, completion of MIMIC Phase 2 chip fabrication and continue assembly of MIMIC modules and brassboards. ($79.6M)

(U) FY 1995 Program:

- Completion of program including delivery of MIMIC chips, modules and brassboards and demonstrations of advanced technology and hardware. ($22.3M)

(U) FY 1996 Program:

- Not applicable. No funds requested.

(U) FY 1997 Program:

- Not applicable. No funds requested.

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DATE
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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-02

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	79.9	25.2	0	0
Current Budget	79.6	22.3	0	0

(U) **Change Summary Explanation:**

FY 1994   Reduction represents minor below threshold reprogramming.

FY 1995   Reduction reflects below threshold reprogramming to fund congressional TRP earmarks.

(U) **Schedule Profile:**

Plan   **Milestones**

Jun 94   Complete fabrication of MIMIC chips.

Jan 95   Deliver MIMIC Phase 2 chips, modules and brassboards.

Jan 95   Complete integrated design/fabrication/test capabilities at MIMIC Phase 2 contractors.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development		R-1 ITEM NOMENCLATURE Electronics Manufacturing Technology, PE 0603739E				DATE September 1994		
COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
IR Focal Plane Array MT-03	41,429	44,809	37,661	19,400	0	0	0	0	0	N/A

(U) **Mission Description:** The Infrared Focal Plane Array (IRFPA) project establishes a manufacturing base for advanced infrared (IR) sensor arrays required for major weapon systems. Improvements in infrared materials, detector array fabrication, readout electronics, cryogenic testing and module assembly are addressed in order to provide affordable infrared sensors to system developers. Systems requiring affordable tactical infrared focal plane arrays include missile seekers, airborne and ground-based target acquisition systems, and infrared search and track systems. Currently, the IRFPAs are produced at low rates and high cost with technology that is just emerging from the laboratory environment. The goal of this project is to produce IRFPAs that meet system requirements with a hundredfold cost reduction relative to the cost at the beginning of the project, and to provide a capability to produce focal plane arrays at low cost in low volume.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Demonstrated imaging of a 480x640 long wavelength staring array fabricated on a silicon wafer with improved structure and low defect density. ($4.0M)
- Established repeatability of system compatible 480x4 scanning arrays and 64x64 staring arrays meeting tactical system requirements. ($15.0M)
- Designed and fabricated high performance read-out integrated circuit with improved linearity meeting mid and long wavelength requirements. ($5.4M)
- Completed evaluation of high speed, long wavelength, 11.0 micron at 68 degrees kelvin for a 480x4 focal plane array for airborne applications. ($6.0M)
- Completed analytical model of defect formation energies in infrared materials. ($1.0M)
- Completed design of flexible manufacturing line including laboratory demonstration of processes. ($10.0M)

(U) FY 1995 Program:

- Demonstration of one-hundred times (X100) cost reduction for 480x4 infrared focal plane arrays useful for ground and airborne applications. ($9.8M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-03

- On-line demonstration of electrical functionality probing of detector arrays on wafers. ($3.0M)
- Demonstration of 128x128 infrared focal plane array with improved spatial uniformity for missile seeker applications. ($5.0M)
- Integration of completely dry processing into the infrared detector fabrication line. ($7.0M)
- Laboratory demonstration of cluster tool concept for flexible manufacturing of IRFPAs. ($20.0M)

(U) FY 1996 Program:

- Demonstrate automated thin film deposition and etching work cell for multiple focal plane array configurations. ($5.0M)
- Complete development of standard electronic cells for rapid design and fabrication of infrared read-out integrated circuits. ($8.0M)
- Verify performance of cryogenic packing vacuum seal; and vacuum bake-out workstation. ($5.0M)
- Complete development of computer aided design files for rapid prototype of infrared cryogenic packages. ($5.0M)
- Demonstrate uncooled focal plane arrays hybridized to low noise analog readout circuits. ($4.7M)
- Complete the development of an integrated manufacturing capability for large-area (4-inch diameter) infrared sensitive semiconductor wafers. ($10.0M)

(U) FY 1997 Program:

- Incorporate into the cryogenic factory the capability to rapidly design and build prototypes of new cryogenic packages. ($3.0M)
- Demonstrate capability to produce multiple cryogenic package designs on the same manufacturing line. ($5.4M)
- Achieve capability to monolithically integrate infrared material on silicon read-out circuits. ($3.0M)
- Fabricate infrared read-outs using a 0.8 micron CMOS process, establishing the capability to fabricate high density staring arrays. ($3.0M)
- Demonstrate flexible, modular IRFPA manufacturing with the capability to rapidly reconfigure the line to produce 3-5 and 8-12 micron arrays for tactical and space surveillance applications. ($5.0M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Electronics Manufacturing Technology,
BA 3 Advanced Development	PE 0603739E, Project MT-03

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	41.4	44.8	43.2	14.4
Current Budget	41.4	44.8	37.7	19.4

(U) **Change Summary Explanation:**

FY 1996-97 Shift of $5 million from FY 1996 to FY 1997 was necessary to accommodate a change to the factory demonstration schedule.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**

Milestones

Plan
Aug 95   Demonstrate a 100 times cost reduction in the manufacture of two-dimensional, staring IRFPAs.
Sep 95   Assemble scalable focal plane array facility.
Jan 96   Demonstrate process module concept for multipurpose scanning arrays.
Jun 96   Demonstrate equipment with flexibility to produce various IRFPA configurations on the same line.
Sep 96   Demonstrate large-area staring and scanning array for search and track, target acquisition, and missile seeker systems.
Sep 97   Demonstrate high-yield IRFPA manufacturing facility capable of varying production rates from small lots to high throughput rates.
Dec 97   Completion of modular infrared focal plane array manufacturing capability, scalable from low volume (single wafer processing) to higher production volume (ten wafer lots @ over 10,000 wafers per year); with single wafer cycle time of ten days.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Electronics Manufacturing Technology
BA 3 Advanced Development	PE 0603739E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Electronic Module Technology MT-04	115,274	128,325	156,812	141,823	152,089	161,872	207,564	231,534	Continuing	Continuing

(U) **Mission Description:** The Electronic Module Technology Project is a broad initiative to substantially decrease the cost and increase the performance of weapon systems through the timely insertion of state-of-the-art electronic modules. Electronic module technology addresses the interconnection and physical packaging of various types of digital and analog integrated circuits, as well as other electronic, electro-optical and micro-mechanical components. It includes traditional approaches such as printed circuit boards, emerging technologies such as high density multichip modules (MCMs), and revolutionary approaches such as "conformal electronics".

(U) The project has four major objectives: (1) shorten the overall design, manufacture, test, and insertion cycle for advanced electronic subsystems; (2) advance the state-of-the-art in electronic interconnection and physical packaging technology to allow circuits to operate close to their intrinsic maximum speed with less overhead in terms of volume, weight and cost; (3) provide a robust manufacturing infrastructure for electronic modules; and (4) demonstrate the system level payoff of electronic module technology through advanced technology demonstrators (ATDs).

(U) The project has the following major elements: (1) High-Density Physical Packaging; (2) Application Specific Electronic Modules (ASEM); (3) Multichip Integration (MCI); (4) Rapid Prototyping of Application Specific Signal Processors (RASSP); (5) Microelectromechanical Systems (MEMS) and (6) High Density Microwave Packaging (HDMP). High-density physical packaging will develop and exploit high-density packaging technology for digital and mixed analog/digital electronics with clock rates up to several GHz and manufacturing processes that will lead to the production of complex shape, lightweight, and high density microwave frequency multichip modules and sub arrays. ASEM will reduce the non-recurring engineering time and cost for designing and inserting complex electronic modules. MCI will produce order of magnitude reductions in manufacturing cost and accelerate the acceptance and insertion of multi-chip integration technologies. RASSP is a major ARPA/tri-Service initiative which seeks to dramatically reduce the development time and life cycle cost of advanced signal processing capability while ensuring state of the art performance when the processor is fielded, not just when it is first defined. MEMS enables information and control technology for mobile systems/active individuals by developing and using microdynamic devices and systems, wireless/low-power communications and conformal/embedded manufacturing. HDMP is developing microwave frequency, thin, lightweight multi-chip packages for use in applications such as active scanned arrays. It is expected to result in cost reductions of up to 75% compared to present approaches with excellent performance.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-04

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Continued development and demonstration of 10-100X packaging density improvement for digital processors, memories, and analog circuits operating at clock rates up to 500 MHz. ($5.5M)

- Continued the ASEM program with additional support for the flexible-access foundry system focusing on the board level integration of MCMs. Demonstrated 2 month turn-around time for MCM designs. Fabricated MCMs for insertion into computer workstation. ($25.1M)

- Continued the MCI program with the establishment of large format equipment development programs and the initiation of selected MCM insertions. ($27.9M)

- Expanded RASSP evaluation and technology base development and demonstrated first versions of design environment. ($37.3M)

- Initiated environmentally conscious electronics systems manufacturing. ($20.0M)

(U) FY 1995 Program:

- Develop microwave frequency multichip module housings, internal packaging interconnections, array interconnect technology, module assembly and integration and CAD tools and databases. ($5.5M)

- Continue the ASEM program with heightened emphasis on mixed signal modules and application demonstrations. Deliver new software tools to streamline the error-free design of MCMs. ($29.2M)

- Continue the MCI program with further development of manufacturing equipment, with a focus on the delivery of production modules for military aircraft and other dual-use applications. Demonstrate pilot production line for roll-to-roll fabrication of high density laminate MCMs. ($24.2M)

- Demonstrate improved signal processor design environment incorporating advanced CAD technology, VHDL extensions, and new signal processing algorithms. Complete first RASSP system demonstration prototypes and deliver preliminary RASSP benchmark evaluations. Initiate technology transition activities. ($44.6M)

- Develop high-yield, high-uniformity, integrated electrical/mechanical fabrication processes for microelectromechanical components and systems and merge with related fabrication technologies in optoelectronics, wireless and microwave devices. ($24.8M)

(U) FY 1996 Program:

- Complete development of required microwave packaging approaches and interconnection circuitry; produce and demonstrate required multi-chip microwave assemblies. ($19.4M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-04

- Demonstrate complete end-to-end RASSP design framework with additional demonstration hardware and benchmark evaluations. Develop accelerated framework standards, improved CAD technology for system testing, and VHDL reuse libraries. Accelerate technology transfer activities. ($39.1M)

- Increase density of integrated, co-fabricated electrical/mechanical components to enable new MEMS applications in data storage, parts handling, and chemical processing. Expand infrastructure development to include MEMS design, manufacture, test and characterization tools. Initiate systems demonstrations. ($42.0M)

- Continue ASEM program to reach one month turn-around time and $25K NRE cost for digital MCMs. Demonstrate high volume production technology for producing known-good die. ($30.0M)

- Continue multi-chip integration program with the delivery of high volume/low cost laminate MCM technology and develop optimized modules and develop optimized modules and mixed signal applications. ($26.3M)

(U) FY 1997 Program:

- Demonstrate microwave packaging array performance of advanced multi-chip assemblies; deliver all required hardware and program documentation. ($20.0M)

- Demonstrate final end-to-end RASSP signal processor design environment. Complete technology insertion demonstrations, benchmarking analysis, and technology transition activities. ($7.0M)

- Demonstrate MEMS applications using massively parallel MEMS systems in new dual-use areas including analytical instruments, precision assembly, active structural enhancement, and air vehicle control. ($47.0M)

- Continue ASEM program and demonstrate new ASEM foundry capability for flexible production of modules with board-level integration. ($32.8M)

- Continue multi-chip integration program to demonstrate order of magnitude reductions in MCM manufacturing costs and MCM technology insertions. Continue insertion of MCM technology into dual-use products such as workstations, engine control and wireless communications. ($35.0M)

(U) Program to Completion: This is an ongoing effort for the transitioning of software technology (utilizing state of the art software engineering techniques and methods) and promulgating software use throughout the defense industry.

(U) **Schedule Profile:** N/A

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-04	September 1994

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	117.6	130.9	146.5	85.8
Current Budget	115.8	128.3	156.8	141.8

(U) **Change Summary Explanation:**

FY 1994   Reduction due to below threshold reprogrammings to Management Headquarters.
FY 1995   Reduction due to below threshold reprogrammings to finance TRP earmarks.
FY 1996-97 Adjustments reflect repricing to fully fund approved programs.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**

Milestones
Plan
Feb 95   Demonstrate ASEM $50,000 non-recurring engineering cost 60 day cycle time for 10 chip Multichip
          Modules.
Mar 95   Demonstrate MCM insertions in OH-58D Image Processor.
Mar 95   Establish quick-turnaround SEM-E board foundry.
Sep 95   Complete high density microwave packaging (HDMP) initial development of housings, inter-chip and
          inter-layer interconnections and testing.
Sep 95   Complete HDMP developments of initial versions of specialized microwave packaging CAD tools and
          databases.
Mar 96   Demonstrate improved versions of RASSP design environment.
Jun 96   Complete HDMP final development of housings, interconnect approaches and perform initial module
          testing.
Jul 96   Demonstrate ASEM Technology for assuring known-good die.
Aug 96   Begin assembly of HDMP brassboard array and perform initial testing.
Sep 96   Deliver MCI Manufacturing Technology to the dual-use market.
Sep 96   Initiate MEMS system demonstrations.
Mar 97   Demonstrate microwave packaging array performance.
Jun 97   Demonstrate final end-to-end RASSP signal processor design.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-04

Jul 97   Demonstrate new dual-use MEMS applications.

Sep 97   Demonstrate new mixed signal ASEM foundry capability.

Apr 98   Insert MEMS Technology into dual-use products and applications.

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	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Electronics Manufacturing Technology, PE 0603739E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Tactical Display Systems (TDS) MT-05	9,263	15,030	25,801	23,169	29,735	27,546	30,500	40,500	Continuing	Continuing

(U) **Mission Description:** This project is a major DoD effort to develop the technology for displays and portable information systems for use in a variety of military systems. This technology is important for virtually all DoD applications which involve visual and graphic information. Major applications of this technology include small combat durable displays for head mounted, hand held, or otherwise portable systems that will be used in aircraft and helicopter cockpits, armored vehicles, submarines, AEGIS cruisers, aircraft carrier flight decks, military simulators, command centers and individual infantrymen. This technology will provide greater resolution for the smaller intelligence and reconnaissance platforms required for potential future conflicts and greater combat durability for these display systems based upon modular design concepts. A major objective of this program is to develop small displays and to integrate these into ongoing and future military portable information systems to significantly improve mission effectiveness for individual combatants and small groups.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Completed development of 640 x 480 pixel monochrome liquid crystal display. ($3.2M)
- Integrated 640 x 480 pixel monochrome liquid crystal display into a Combat Vehicle Crew head mounted system and demonstrated at the U.S. Army Armor Conference. ($2.6M)
- Completed all designs and first process runs of 1280 x 1024 pixel liquid crystal and electroluminescent displays. ($3.6M)

(U) FY 1995 Program:

- Head Mounted Displays - Emphasis will be on demonstrating a Combat Vehicle Crew head mounted display system in an M1A2 tank and initiating a program to develop 2560 x 2048 liquid crystal and electroluminescent displays in a one-square inch format. ($9.1M)
- Tactical Information Assistants - This effort will develop light, thin, portable information systems for active, mobile users that focus on rapid prototyping with end-users in the design loop. Emphasis will be on modifying a field qualified, hand-held laser rangefinder to provide improved surveillance information gathering and transmission. ($5.9M)

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RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-05

(U) **FY 1996 Program:**

- Head Mounted Displays - Emphasis will be on continuing the development of 2560 x 2048 liquid crystal and electroluminescent displays, significantly decreasing the voltage requirements for electroluminescent displays and demonstrating a high-resolution head mounted display for dual-use medical applications. ($12.2M)

- Tactical Information Assistants - Emphasis will be on demonstration of three systems for use by individuals remotely located from conventional information sources. ($13.6M)

(U) **FY 1997 Program:**

- Head Mounted Displays - Complete development of 2560 x 2408 pixel displays and demonstrate in a military head mounted application. ($9.6M)

- Tactical Information Assistants - Initiate development of TIAs emphasizing the combination of computation, communication and navigation in a single unit. Initiate an effort to significantly improve the assembly and manufacturing of previously defined TIAs. ($13.6M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	9.4	16.2	21.2	22.2
Current Budget	9.4	15.0	25.8	23.2

(U) **Change Summary Explanation:**

FY 1995   Reduction due to minor reprogramming to fund TRP earmarks.

FY 1996-97 Adjustments reflect minor repricing.

(U) **Other Program Funding Summary Cost:**   N/A

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Electronics Manufacturing Technology, PE 0603739E, Project MT-05

(U)   **Schedule Profile:**   N/A

Milestones

Plan

Sep 94	Complete development of 1280 x 1024 pixel 1-inch displays.
Dec 94	Complete development of head mounted mechanical configuration with optics and initiate modification of hand-held laser rangefinder.
Nov 94	Initiate super high-resolution display development.
Dec 94	Demonstrate CVC HMD.
Jun 95	Demonstrate "eyeglass-like" displays.
Nov 96	Demonstrate modification of hand-held laser rangefinder.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
MAFET MT-06	0	24,169	28,399	33,133	54,981	55,201	62,467	68,012	Continuing	Continuing

(U) **Mission Description:** Microwave and millimeter-wave frequency technology for DoD electronic weapon systems is at a critical crossroads. Great progress has been made under the MIMIC program: many integrated circuits are available, chip costs are going down, and DoD weapon systems are benefiting. However, in many cases, chip and module costs are still a major impediment to fielding cost effective DoD weapon systems. Technology and infrastructure advances must be undertaken to sustain an effective defense capability and to maintain U.S. dominance in this critical technology area. The Microwave and Analog Front End Technology (MAFET) program will ruthlessly drive down non-recurring costs through improved computer aided design capabilities. It will provide urgently needed improvements in the performance and affordability of microwave and millimeter wave integrated circuits and modules. It will complement industry investments in related commercial technology. However, commercial microwave solid state technology does not have the performance characteristics to meet DoD weapon system needs. The MAFET program is the essential foundation for all DoD systems and programs making use of microwave/millimeter-wave solid state technology.

(U) The program will accomplish the following urgently needed tasks: (1) it will reduce design time and cost for every microwave system being developed or upgraded through an improved microwave/millimeter wave design environment. It will break the very expensive and time consuming current practice of design-build-test--redesign-rebuild-retest; (2) It will develop affordable, high performance sensors that must be available in order to field an effective defense. It will develop affordable products that allow troop protection from "friendly fire", that make possible more accurate weapon systems, that enhance the ability to "see" under all weather conditions, and that provide low power consumption, very portable, effective communication systems.

(U) MAFET will help to sustain the microwave and millimeter-wave industrial base that must be in place to meet DoD requirements. If MAFET is not undertaken, this base will shrink below minimum acceptable levels, U.S. dominance of microwave and millimeter-wave technology will end, effective defense will be at risk, many jobs will be lost, and many lives may be lost because of inadequate weapon systems.

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-06

(U) **Program Accomplishments and Plans:**

(U) **FY 1995 Program:**

- Begin implementation of microwave/millimeter wave computer aided design environment that will reduce non-recurring chip/module/system costs by providing improved design, simulation, synthesis and cost analysis capabilities. This task includes enhancement of CAD tools specifically needed for microwave and millimeter wave circuit use (**not** digital circuit design tools which are different), tool set integration, effective use of performance and cost databases, needed circuit and module model development, and work on the needed Microwave Hardware Description Language (MHDL). ($12.7M)

- Develop advanced sensor technology including needed integrated circuit improvements in performance and yield, needed advanced material development (i.e., indium phosphide), improvement of related passive microwave and millimeter-wave components, development of needed interconnection approaches, improved packing (particularly at millimeter-wave frequencies), and improvements of test and assembly methodologies. ($11.5M)

(U) **FY 1996 Program:**

- Continue microwave/millimeter-wave computer aided design environment development with quantitative demonstration of ability to reduce time and cost of producing microwave/millimeter-wave products; continue development and implementation of MHDL. ($13.5M)

- Continue development of advanced sensor technology with demonstrations of improved performance coupled with cost savings. ($12.0M)

- Select most appropriate system application areas and begin benchmarking demonstration tasks that will allow quantitative assessment of sub-system and system performance improvements and cost savings resulting from MAFET activities. ($3.9M)

(U) **FY 1997 Program:**

- Continue microwave/millimeter-wave computer aided design environment development with implementation of advanced microwave/millimeter-wave CAD tools and integrated tool sets and implementation of improved models and cost analysis tools; conduct assessment and demonstration of design environment effectiveness through quantitative assessment of benchmarking metrics; continue development and implementation of MHDL. ($15.3M)

- Continue development of advanced sensor technology with demonstrations of improved performance coupled with cost savings. (13.0M)

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APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Electronics Manufacturing Technology,
BA 3 Advanced Development	PE 0603739E, Project MT-06

- Provide quantitative demonstrations of performance improvements and cost savings achieved through MAFE program activities for selected, critical system applications. ($4.8M)

(U) <u>**Program Change Summary:**</u> *(In Millions)* <u>FY 1994</u> <u>FY 1995</u> <u>FY 1996</u> <u>FY 1997</u>

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	0	24.5	54.5	68.3
Current Budget	0	24.2	28.4	33.1

(U) <u>**Change Summary Explanation:**</u>

FY 1995   Reduction due to minor reprogramming.
FY 1996-97 Adjustments reflect program rephasing.

(U) <u>**Other Program Funding Summary Cost:**</u> N/A

(U) <u>**Schedule Profile:**</u>

Plan	Milestones
Nov 94	Initiate first RFP or BAA for MAFET development contracts.
May 95	Award first MAFET development contracts.
Nov 95	Initiate additional RFP or BAA for MAFET development contracts.
May 96	Award second MAFET development contracts.
Dec 96	Demonstrate enhanced mm-wave frequency integrated circuits.
Dec 96	Demonstrate extensions of design, fabrication, testing and assembly capabilities.
Mar 97	Demonstrate efficient, low cost, manufacturing and assembly approaches for highly integrated microwave circuit and module assemblies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Electronics Manufacturing Technology, PE 0603739E

COST (In Millions)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Centers of Excellence MT-07	23,837	23,000	14,000	10,000	0	0	0-	0	0	N/A

(U) **Mission Description:** This project provides funding for the following Centers of Excellence: Robert C. Byrd Institute for Advanced Manufacturing at Marshall University; Greater Philadelphia Consortium for Science and Technology, and Focus: Hope National Center for Advanced Technologies. The purpose of these Centers is to demonstrate, deploy and provide advanced manufacturing technology to significantly reduce unit production and life cycle costs, improve product quality, and deploy manufacturing training systems. The Institute for Advanced Flexible Manufacturing provides both a teaching factory and initiatives to local area industries to utilize computer-integrated manufacturing technologies and managerial techniques to improve productivity and competitiveness. The National Center for Advanced Technology (NCAT) is a component of the Focus: Hope Project whose purpose is to train technicians/engineers in advanced manufacturing processes and methods, demonstrate state-of-the-art flexible manufacturing and serve as a testbed for emerging manufacturing research. The Greater Philadelphia Consortium, which is comprised of the Franklin Institute, Drexel University and the Eastern Technology Council, will conduct computer software research and establish the Center For Computing Excellence.

(U) **Program Accomplishments and Plans:**

(U) **FY 1994 Accomplishments:**

- Developed contracts, determined manufacturing requirements, purchased the install manufacturing equipment and entered production for the 4th through 7th of the eleven planned manufacturing neighborhoods at National Center for Advanced Technologies (NCAT) increasing overall defense production rates to 10,000 parts per month. ($19.8M)

- Institute for Advanced Flexible Manufacturing. Continued the ongoing technology development, technology evaluation, and technology transfer to local business. Provided system integration, supported CALS commercialization, client assistance for federal contracts, technology training through seminars and workshops, and research into dual-use flexible manufacturing. ($4.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-07	September 1994

(U) **FY 1995 Program:**

- Complete the installation of the planned manufacturing neighborhoods at NCAT. ($15.0M)
- Initiate manufacturing education and training program to develop a Center for Computing Excellence. ($4.0M)
- Initiate research effort to develop a software package and online database to provide interactive capabilities for teachers to use internet for teaching science, math and technology. ($4.0M)

(U) **FY 1996 Program:**

- Develop, demonstrate and evaluate new technologies for insertion and transfer to manufacturing centers and industry, with a focus on small to medium manufacturing companies. ($7.0M)
- Develop software to integrate 3D computer model with numerically controlled machine tools, and demonstrate its production capability. ($4.0M)
- Demonstrate an electronic (digital) library in the context of education and training of machinists. ($3.0M)

(U) **FY 1997 Planned Program:**

- Continue the development, demonstration and evaluation of new technologies for insertion and transfer to manufacturing centers and industry, with a focus on small to medium manufacturing companies. ($5.0M)
- Integrate all the manufacturing stations to demonstrate the ability to accept an order, automatically generate machining plans, automatically create a schedule for the machines, and execute the plans on the machines to create the desired component. ($5.0M)

(U) **Program Change Summary:** (In Millions)

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	23.8	15.0	15.0	10.0
Current Budget	23.8	23.0	14.0	10.0

(U) **Change Summary Explanation:**

FY 1995 $8 million was added to finance the Greater Philadelphia Consortium.
FY 1996   Adjustments reflect minor repricing.

(U) **Other Program Funding Summary Cost:**   N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-07

(U) **Schedule Profile:**

Plan   **Milestones**

Sep 94   Complete installation of the 4th through 7th manufacturing neighborhoods.

Sep 95   Complete installation of the manufacturing neighborhoods.

Sep 95   Complete Center for Computing Excellence at the Greater Philadelphia Consortium.

Sep 96   Develop, demonstrate and evaluate technology insertion and technology transferred to medium and
small manufacturing companies.

Mar 97   Evaluate impact of program on small to medium manufacturing times.

Nov 97   Complete transition of manufacturing technology.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Manufacturing Technology Initiatives MT-08	7,186	14,342	27,800	29,112	35,920	25,000	25,000	25,000	0	N/A

(U) **Mission Description:** Future military systems, such as sensors and missile seekers, will be affordable only if the manufacturing process is considered as an integral part of product design and if production takes place in flexible, multi-product factories. This program will focus on process technology demonstrations, providing prototype flexible factories with integrated design and manufacturing systems as well as prototype products. The Flexible Design and Assembly in the Missile Manufacturing Sector, an Advanced Technology Demonstration, will be initiated in FY 1995.

(U) The FDAMMS program will develop and integrate design and flexible manufacturing systems including automated design-for-assembly tools, factory planning and control systems, advanced factory simulations, and flexible high precision assembly and checkout systems to demonstrate the capability to reduce the cost of complex electro-mechanical products with missile and munition seeker assemblies as initial targets. FDAMMS will develop a multi-missile manufacturing environment to optimize cost across a mix of different missiles. The goal is to reduce existing missile seeker costs by at least 10% and new missile seekers by at least 30%. These programs will establish new benchmarks for cost and schedule reduction in the tactical missile industry sector. Vendor involvement will result in design and manufacturing systems which can be applied to numerous analogous military and commercial applications.

(U) Technology base demonstrations of a prototype networked manufacturing systems infrastructure were completed in FY 1994. The networked infrastructure will link computer aided design, engineering, and analysis with manufacturing systems, and will more effectively integrate dissimilar design and manufacturing systems for both military and commercial use.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:
- Completed program to lower the cost of polymer matrix composites via improved manufacturing processes. ($3.8M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-08	September 1994

- Demonstrated a networked infrastructure linking computer-aided design, engineering, and analysis with manufacturing systems. ($3.4M)

(U) FY 1995 Program:

- Complete baseline and technology insertion assessment studies to determine key leverage points to lower total costs and cycle times for High Performance Electro-Mechanical (HPEM) devices such as missile/munition seekers. Assessments will include dual-use commercial technology. The baseline studies will provide quantitative basis and metrics for the FDAMMS ATD evaluation. Identify and define service design exercises to evaluate new tools and factory processes and develop the user links for the manufacturing capabilities to be developed. ($2.0M)

- Begin the design and simulation of advanced flexible manufacturing pilot factories using advanced manufacturing processes and tools that are currently available. Identify new tools and methods that will need to be developed in parallel research efforts in advanced engineering tools and flexible factory technologies. In FY 1995/96 these pilot factories will simulate new manufacturing capabilities to assess the effectiveness of factory system design. These factories will integrate product/process (IPPD) design tools for application to infrared seekers and will include an electronic information infrastructure to facilitate the development of a manufacturing enterprise. ($8.5M)

- Begin the development of advanced engineering tools, methods, and processes for the HPEM devices with application to missile seekers. Award research contracts for the development of advanced cost analysis and risk assessment tools and methods for design and production of HPEM devices including missile seekers. This work will be the collaboration of industry, university, vendor and government laboratories. ($3.8M)

(U) FY 1996 Program:

- Continue the work on baselining and benchmarks to measure progress in developing an advanced manufacturing environment. Initiate design exercises defined in FY95 for simulated manufacturing evaluation. ($3.5M)

- Continue the development and simulation of advanced flexible pilot factories including IPPD, dual-use capability, multiple product (HPEM, missile seeker) capability, electronic enterprise integration, and design and manufacturing tools and processes. Conduct design exercises to validate the IPPD capabilities in representative missile seeker applications. Complete the integration of all available tools and processes for demonstrations of factory capabilities in FY 1997. ($20.0M)

- Continue work on the development of specialized tools, methods, models, and processes to complete the integrated design and manufacturing environment. Initiate alpha testing of these technologies and start planning for insertion into the pilot factories in FY 1997. ($4.3M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-08

(U) FY 1997 Program:

- Continue the work on baselining and benchmarks to measure manufacturing enterprise development progress. Complete the simulation design exercises and begin the definition of the design exercises for the integrated pilot factories. ($4.0M)

- Demonstrate through simulation the capability of the integrated manufacturing enterprise that has been developed from available tools. At the end of FY 1997 begin the implementation of the pilot factories that have been designed in the initial phase. Significant investment by industry is planned to support the hardware/software for the actual factory implementation. ($20.0M)

- Complete contractor alpha tests and start system integration of the advanced manufacturing tools that have been developed to complete the flexible factory enterprise. Continue the development of additional tools and technology that has been identified by the factory simulations and design exercises. ($5.1M)

(U) **Program Change Summary:**   (In Millions)

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	6.7	14.3	27.8	32.1
Current Budget	7.2	14.3	27.8	29.1

(U) **Change Summary Explanation:**

FY 1994   Increase to fund OPDUSD (A&T) study to accelerate implementation of acquisition reform.
FY 1997   Reflects reduction to satisfy POM adjustments.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**

Plan   Milestones
Apr 95   Initiate Pilot Flexible Factory Development contracts.
Jun 95   Initiate Advanced Engineering Tool Development contracts.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY	**R-1 ITEM NOMENCLATURE**
RDT&E, Defensewide	Electronics Manufacturing Technology,
BA 3 Advanced Development	PE 0603739E, Project MT-08

Jun 96	Complete development and alpha test of advanced CAD tools, process planners and simulation models.
	Demonstration of design system application to low end missiles.
Jun 96	Simulation demonstrations of advanced manufacturing capabilities.
Sep 96	Flexible factory simulations completed.
Jun 97	Initiate development of design systems and flexible factory systems for FDAMMS.

UNCLASSIFIED

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE
September 1994

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 3 Advanced Development

R-1 ITEM NOMENCLATURE
Electronics Manufacturing Technology,
PE 0603739E

COST *(In Thousands)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Dual-Use Design and Manufacturing MT-09	0	20,180	21,335	22,467	8,985	0	0	0	0	N/A

(U) **Mission Description:** An essential element of the new defense strategy is dual-use manufacturing. DoD will increasingly rely on commercial production lines to produce military variants of their products for incorporation into weapon systems. This project focuses on the flexible process technology including advanced design systems, scalable components and subsystems, advanced materials and processing, flexible factory systems and manufacturing operations control needed to implement this strategy. The program will initiate two sub-projects, Interferometric Fiber Optic Gyroscopes (IFOG) and Manufacturing Systems Technology for Electric Drive Systems (MSTEDS) in product areas with a potentially large commercial market. The emphasis will be on achieving the design and manufacturing flexibility required to make low volume Defense access to high volume commercial production economically viable.

(U) Interferometric Fiber Optic Gyroscopes are emerging as preferred technology for future commercial inertial navigation applications. The Low Cost IFOG Manufacturing project will develop the large throughput robotic assembly, packaging and testing technologies necessary to fabricate miniature navigation-grade (1 nm/hr) IFOG inertial measurement units (IMUs) at <$1500 per axis as a goal. Miniature navigation-grade IMUs are essential to precision strike weapon systems required to accurately navigate through extended periods of Global Positioning System (GPS) outage due to enemy jamming. Example technology development areas include: (1) low loss, low reflectivity, polarization-preserving optical connectors between optical fiber subassemblies, and optical sources, detectors and miniature integrated optical circuits (MIOCs); (2) rapid, precision coil winding machines; (3) geometrically stable, environmentally robust (temperature and vibration) packaging of critical optical subassemblies; (4) large volume MIOC foundry processes; and (5) automatic testing machines. Phase 1 will identify Gyroscope IFOG manufacturing requirements. Phase 2A will develop precision robotic interconnection of IFOG optical parts and subassemblies: for environmentally robust, optically stable IFOG component and subassembly packaging facilities; for rapid, precision coil winding machinery; for large batch processing Multifunction Integrated Optical Circuit foundry; and for automatic test equipment. Phase 2B implements the refined manufacturing processes and controls for final configuration IFOG units. Phase 3 designs and establishes a prototype automated, flexible IFOG manufacturing facility, transitioning the manufacturing processes and control from Phase 2B.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-09	September 1994

(U)   The above areas have been identified due to their current dependence on specialized technical labor or because of more stringent requirements for navigational grade gyroscopes as compared with current tactical grade gyroscopes. The current manufacturing technologies for coil winding and multifunction integrated optical circuits fabrication are too slow, too labor intensive and too inconsistent. Improved processes and process controls will be required to lower cost and improve quality.

(U)   The Manufacturing Systems Technology for Electric Drive Systems (MSTEDS) targets electric drive systems between 20-750 horse power (HP) for demonstration of advanced design and dual-use manufacturing systems.   These devices have broad use in DoD and commercial applications and provide a current application for demonstration of dual-use factories.   The project will demonstrate Integrated Product/Process Design systems that will integrate performance and manufacturing process requirements for new designs prior to prototyping; factory simulation systems; physics-based models and control systems for processing advanced materials; advanced cost models; flexible factory planning and control systems for low cost automated manufacture of advanced electric drive systems. This project will leverage significant anticipated industry investment through cooperative efforts which integrate DoD high performance requirements with commercial requirements for low-cost, rapid response and reliability. Dual-use objectives will require concentration on families of subsystems and components designed from the start for flexible manufacturing, and on flexible factory systems.

(U)   **Program Accomplishments and Plans:**

(U)   <u>FY 1994 Accomplishment:</u> Project starts in FY 1995.

(U)   <u>FY 1995 Program:</u>

- Competitive awards for innovative integrated process and product development of components of motors and motor controllers, including design tradeoffs, simulation of component behavior, and planning of flexible manufacturing processes. ($2.0M)
- Develop new flexible manufacturing, factory control reference architectures, factory models, and intelligent manufacturing resource planning systems. ($3.0M)
- Develop innovative materials-based and physics-based manufacturing process models for motor drive components. ($2.0M)
- Simulation based design of electric drive systems for aircraft, land combat vehicles, and maritime systems; and prepare specifications for prototypes of electric drive parts and assemblies. ($2.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Electronics Manufacturing Technology,
BA 3 Advanced Development	PE 0603739E, Project MT-09

- Conduct Interferometric Fiber Optic Gyroscope Phase 1 and initiate winding and affordable optical source efforts. ($7.5M)
- Initiate Phase 2A. ($3.7M)

(U) FY 1996 Program:
- Continue advanced manufacturing process development and controls for components and complete preliminary Interferometric Fiber Optic Gyroscope units. ($16.3M)
- Begin evaluation of assembled Phase 2A units. ($5.0M)

(U) FY 1997 Program:
- Complete evaluation of Phase 2A IFOG units. ($3.0M)
- Conduct Phase 2B. ($15.0M)
- Initiate Phase 3 (e.g, procure long-lead items). ($4.5M)

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	0	25.2	44.7	46.8
Current Budget	0	20.2	21.3	22.5

(U) **Change Summary Explanation:**

FY 1995   Decrease reflects reprogramming to fund TIER 3 UAV.
FY 1996-97 Adjustments reflect offsets to satisfy directed POM requirements.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**

Plan   Milestones
Apr 95   Award Interferometric Fiber Optic Gyroscope manufacturability contracts.
Jun 96   Conduct initial demonstrations of IFOG design systems and critical manufacturing processes.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Lithography MT-10	57,931	10,000	40,000	61,800	65,300	50,000	45,000	45,000	Continuing	Continuing

(U) **Mission Description:** Lithography technology has enabled the dramatic growth of integrated circuit (IC) capability over the past two decades. Advances in lithography lead directly to improvements in electronic and computing systems performance in terms of speed, power, weight and reliability. Advanced microelectronics technology is essential for computing, data and signal processing, and communications for both civilian and military needs. Specific defense applications include smart weapons, radar, electronic warfare, sensing, communications, command and control, and surveillance. Further improvements in areas such as target recognition, autonomous guided missiles and beam forming for sonar and radar will require microcircuits with smaller features in order to meet the power, weight and volume constraints of these systems.

(U) Current microelectronics manufacturing utilizes 0.5 micron minimum feature sizes. This effort develops subsystems and systems to establish manufacturing capability at 0.18 - 0.1 microns for late 1990s manufacturing. Because the optimal cost-effective lithography approach for these future generations of technology is not known today, this effort balances investment in competing approaches with a strong emphasis on the common cross-cutting techniques that will be required. Key developments include mask technology (electron-beam tools for pattern writing, mask fabrication demonstration, mask repair tools, and membranes), improved alignment and overlay techniques, metrology, systems development and integration utilizing various radiation sources (x-ray, electron-beam, ion-beam, and optics), and device demonstrations to establish viability of the developed systems.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Improved cross-cutting technologies (mask, alignment) leading to 0.18 micron design rules, including demonstration of a 50KV e-beam mask writer. ($24.0M)
- Initiated efforts to migrate the 0.25 micron aligners to 0.18 micron capability. ($6.0M)
- Continued efforts in ion-beam, electron-beam, and advanced optical lithography, including characterization of the 193 nanometer, exposure system. ($7.0M)
- Demonstrated 0.25 micron logic device fabrication with proximity x-ray and demonstrated pattern definition with improved projection x-ray system. ($15.9M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-10

(U) • Extended x-ray technology into other applications such as coronary applications. ($5.0M)

(U) FY 1995 Program:
- Deliver EL-4 mask writer and demonstrate subsystems for 0.1 micron writer. ($2.5M)
- Develop overlay and processing capabilities for 0.18 micron design rules. ($1.5M)
- Complete design of step and scan system for projection x-ray. ($1.0M)
- Demonstrate subsystems for 0.18 micron tools in ion-beam and electron-beam exposure systems. ($5.0M)

(U) FY 1996 Program:
- Deliver 0.18 micron feature size x-ray and phase shift optical masks from mask shop. ($15.0M)
- Demonstrate prototype projection electron-beam and ion-beam lithography lenses. ($8.0M)
- Demonstrate repair tool for repair of masks with 0.15 micron features. ($5.0M)
- Develop alignment sub-assemblies and sources for 0.12 micron lithography system. ($8.0M)
- Improve output of x-ray point sources. ($4.0M)

(U) FY 1997 Program:
- Demonstrate stage control for lithography tools with 0.12 micron capability. ($4.0M)
- Fabricate devices using soft x-ray reduction techniques. ($3.0M)
- Demonstrate breadboard (alpha) versions of electron-beam and ion-beam projection lithography system. ($16.0M)
- Fabricate masks and devices with .18 micron design rules. ($14.0M)
- Initiate design and build of 0.12 micron stepper. ($10.0M)
- Improve e-beam writing, inspect, repair, and processing for 0.12 mask capability. ($14.8M)

(U) **Program Change Summary:**

(In Millions)	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	58.4	10.0	25.0	25.0
Current Budget	57.9	10.0	40.0	61.8

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE
September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E, Project MT-10

(U) **Change Summary Explanation:**

FY 1994   Minor repricing.

FY 1996-97 Funds added to provide a fully funded program consistent with the Semiconductor Road Map.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**

Plan   Milestones

Dec 95   Demonstrate a "nanowriter" electron-beam tool for writing features at 50 nanometers.
Jun 96   Demonstrate mask repair tool for masks with 0.15 micron features.
Jul 96   Demonstrate source for Extreme Ultra Violet (EUV) (13.5 nm) lithography.
Sep 96   Fabricate devices with 0.18 micron features.
Apr 97   Demonstrate breadboard (alpha) version of electron-beam lithography system.
Jun 95   Deliver EL-4 mask writer for writing 0.25 μm features.
Mar 96   Deliver prototype x-ray and optical phase shift masks with 0.18 μm features.
Aug 96   Demonstrate x-ray source suitable for x-ray prototype tool for 0.18 μm features.
Sep 97   Fabricate devices using EUV lithography.
Mar 97   Demonstrate stage control to 10 nm, suitable for 0.12 micron lithography tools.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Electronics Manufacturing Technology, PE 0603739E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
CALS Shared Resource Centers MT-11	43,000	40,000	19,712	15,000	15,000	0	0	0	0	133,000

(U) **Mission Description:** CALS Shared Resource Centers (CSRC) deploy information technology and tools to facilitate enterprise integration and enhance electronic commerce for business and government in order to improve the competitiveness of the U.S. civil-military industrial base and enhance military preparedness. CSRCs will concentrate on: (1) delivery of information, training and consulting services with special emphasis on small to medium sized enterprises in regional areas throughout the country; (2) delivery of information and expert services to other providers in the nationwide manufacturing extension network; (3) development of critical technologies; and (4) demonstration of developed technologies in a military logistics program.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Cognizance for the CSRC program transferred from Air Force to ARPA.
- Established a new contract and other agreements for continuation of the original CSRC activity as the Department's tri-service CALS standards and technologies development, deployment, training and education hub; and established three new CSRC Regional Satellites as directed by the Congress. ($23.0M)
- Continued operation of the six original CSRC Regional Satellites as directed by the Congress, and establish links to related technology deployment activities. ($20.0M)

(U) FY 1995 Program:

- Continue CALS Shared Resource Center (CSRC) hub activities; develop additional training courses and train instructors for the CSRC Regional Satellites and other manufacturing extension service providers in the nationwide network; enable network access to the online CALS library and to expert consulting services; conduct development, demonstrations and tests of CALS and electronic commerce technology, standards and software focused on manufacturing and logistics applications (including DoD); support DoD and industry groups in CALS outreach forums; demonstrate feasibility of mechanisms to increase the proportion of non-federal funding for the CSRC program. ($20.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Electronics Manufacturing Technology,
BA 3 Advanced Development	PE 0603739E, Project MT-11

• Continue CSRC Regional Satellite activities; expand the depth of specialized expertise unique to each node through technology demonstration projects; increase the number of small and mid-size enterprises in each region reached through CSRC outreach activities; provide training and technical assistance for regional clients in implementing CALS and electronic commerce; demonstrate an initial range of services and information available to other extension service providers in the nationwide network; demonstrate the feasibility of mechanisms to increase the proportion of non-federal funding for operating the regional satellites. ($20.0M)

(U) FY 1996 Program:

• Continue the CSRC hub activities; demonstrate insertion of advanced information technology from other ARPA programs in CALS and electronic commerce applications; conduct development, demonstrations and tests of CALS technology, standards and software focused on manufacturing and logistics applications (including DoD); support DoD and industry groups in CALS outreach forums; implement mechanisms to increase the non-Federal funding share for the CSRC program. ($15.0M)

• Continue CSRC Regional Satellite activities; spin off commercially viable technology and services resulting from specialized expertise unique to each node; further increase the number of small and mid-size enterprises in each region reached through CSRC outreach activities; provide training and technical assistance for regional clients in implementing CALS and electronic commerce; expand the range of services and information available to other extension service providers in the nationwide network; implement mechanisms to increase the share of non-Federal funding for operating the regional satellites. ($5.0M)

(U) FY 1997 Program:

• Continue the CSRC hub activities; demonstrate insertion of advanced information technology from other ARPA programs in CALS and electronic commerce applications; conduct development, demonstrations and tests of CALS technology, standards and software focused on manufacturing and logistics applications (including DoD); support DoD and industry groups in CALS outreach forums; refine mechanisms that increase the non-Federal funding for the CSRC program. ($10.0M)

• Continue CSRC Regional Satellite activities; spin off commercially viable technology and services resulting from specialized expertise unique to each node; transfer retail technology deployment activities to the NIST Manufacturing Extension Partnership. ($5.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Development	R-1 ITEM NOMENCLATURE Electronics Manufacturing Technology, PE 0603739E, Project MT-11

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	43.0	40.0	20.0	15.0
Current Budget	43.0	40.0	19.1	15.0

(U) **Change Summary Explanation:**

FY 1996   Adjustments reflects offsets to satisfy directed POM requirements.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**

Plan	Milestones
Feb 94	Transfer CSRC program from Air Force to ARPA.
Jun 94	Establish agreements for continuation of existing centers.
Sep 94	Establish three new CSRC Regional Satellites.
Sep 95	Complete initial demonstrations, show feasibility of non-Federal cost share.
Sep 96	Demonstrate value of networked access to CSRC services; implement mechanisms for non-Federal cost sharing.
Sep 97	Transition CSRC retail deployment activities to manufacturing extension program beyond RDT&E.
Sep 98	Transition CSRC activities to manufacturing extension program beyond RDT&E.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

		DATE	
		September 1994	

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Advanced Simulation,
BA 3 Advanced Development	PE 0603744E

COST *(In Thousands)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Advanced Simulation (National Guard) SM-01	27,107	20,937	20,899	14,700	20,000	15,000	15,000	18,000	0	N/A

(U) **Mission Description:** In FY 1992, Congress appropriated funds to initiate a program to apply advanced technology to the training of National Guard Roundout Brigades. This program was initiated to respond to issues that developed in the 1991 Desert Shield/Desert Storm mobilization and is now being considered as part of an Advanced Concept Technology Demonstration.

(U) This program element is budgeted in the Advanced Development Budget Activity because its goal is to achieve a significant improvement in training effectiveness required for reserve component maneuver force mobilization through the use of advanced distributed information technologies and innovative training strategies at a lower cost than current active component methods for conducting the same training. The intent is to develop and integrate technologies that enable National Guard soldiers to conduct sophisticated training either at the local community armory, or at the soldier's home. The program will capitalize on existing commercial technologies where feasible, and develop technologies where needed with dual-use potential.

(U) **Program Accomplishments and Plans:**

(U) **FY 1994 Accomplishments:**

- Connected two test brigades to the Defense Simulation Internet (DSI). ($1.2M)
- Continued development of reconfigurable ground simulator. ($4.0M)
- Conducted field trials of brassboard location instrumentation and intervehicular communications technology.
- Executed partial Phase II effort to develop and test prototypes in unit testbeds. ($4.3M)
- Continued development of desktop equipment simulators and advanced technology distributed training capabilities. Priorities are on the maneuver battalion staff, forward support battalion staff, critical vocational skills of support personnel, brigade staff and small unit leaders. ($4.6M)
- Initiated connection of armories in the State of Iowa to the statewide fiberoptic network. ($10.0M)
- Intensified development of measures of performance and program evaluation research. ($3.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Simulation, PE 0603744E, Project SM-01

(U) FY 1995 Program:

- Operate two test brigades on the Defense Simulation Internet (DSI). ($1.5M)
- Conduct initial functionality test of reconfigurable ground simulator. ($1.0M)
- Complete development and assessment of location instrumentation and intervehicular communications technology. ($6.0M)
- Continue development of desktop simulators and advanced technology distributed training capabilities and delivery technologies. ($9.0M)
- Continue development of measures of performance and conduct of program evaluation research. ($3.4M)

(U) FY 1996 Program:

- Operate two test brigades on the Defense Simulation Internet (DSI). ($1.5M)
- Develop innovative training programs and delivery assessment technologies. ($6.0M)
- Continue development of desktop simulators and advanced technology distributed training capabilities and delivery technologies. ($9.1M)
- Continue development of measures of performance and conduct of program evaluation research. ($4.3M)

(U) FY 1997 Program:

- Complete evaluation of two test brigades on the Defense Simulation Internet (DSI). ($1.5M)
- Continue development of innovative training programs and delivery assessment technologies. ($4.1M)
- Complete development of desktop simulators and advanced technology distributed training capabilities. ($5.5M)
- Continue development of measures and conduct of program evaluation research. ($3.6M)

(U) **Program Change Summary:**

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	27.1	20.9	20.9	14.7
Current Budget	27.1	20.9	20.9	14.7

(U) **Change Summary Explanation:** N/A

(U) **Other Program Funding Summary Cost:** N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	DATE
RDT&E, Defensewide BA 3 Advanced Development	Advanced Simulation, PE 0603744E, Project SM-01	September 1994

(U) **Schedule Profile:**

Plan

Milestones

Jan 94	Installed First JANUS 3-D at Brigade HQ.
May 94	Installed JANUS Brigade/Battalion Local Area networks.
Jul 94	Awarded contract for Force-on-Force prototype development.
Jul 94	Initiated Iowa armory connections to Iowa Fiberoptic Network.
Aug 94	Delivered prototype virtual reality equipment simulator.
Aug 94	Delivered first prototype advanced technology training programs.
Sep 94	Conduct brassboard evaluation Phase II Force-on-Force.
Sep 94	Establish DSI nodes for two test brigades.
Dec 94	Deliver proof-of-concept reconfigurable simulator.
Feb 95	Deliver prototype digital library.
Feb 95	Continue delivery of prototype training programs and assessment tool.
Feb 95	Initiate delivery of basic virtual reality equipment simulators.
Feb 95	Field trials of assessment tools.
May 95	Deliver draft assessment measures and plan.
Nov 95	Implement program evaluation program.
Nov 95	Begin delivery of prototype digital libraries and programs.
May 96	Implement assessment tools.
Aug 96	Send first experimental brigade to National Training Center (NTC).
Nov 96	Deliver modified training programs from FY 1996 NTC.
Feb 97	Deliver last equipment simulators.
Aug 97	Send second experimental brigade to NTC.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE September 1994

APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE
RDT&E, Defensewide BA 3 Advanced Development		Semiconductor Manufacturing Technology, PE 0603745E

COST (In Thousands)	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
SEMATECH EM-01	89,250	90,000	90,000	0	0	0	0	0	0	N/A

(U) **Mission Description:** This project supports SEMATECH, a pre-competitive industrial consortium that addresses the long-term semiconductor manufacturing requirements for both military and civilian applications. The goal of SEMATECH is to continue reducing costs while maintaining the state-of-the-art in complexity and performance for silicon technologies. It will concentrate on future factory design and process definition and control efforts for flexible manufacturing of both low- and high-volume devices in the same factory. Environmentally conscious manufacturing, and safety and health of manufacturing personnel are also part of this effort. This project will combine advances in physical equipment with software advances, i.e., fully integrated computer-integrated manufacturing (CIM) systems, and modeling and simulation tools for designing processes, tools, and factories. SEMATECH comprises the companies that supply the majority of the integrated circuits used in defense systems, and it has a proven track record of working with equipment suppliers effectively.

(U) **Program Accomplishments and Plans:**

(U) FY 1994 Accomplishments:

- Completed 0.25 micron semiconductor manufacturing technology process definition. ($63.0M)
- Initiated projects for 0.18 micron semiconductor manufacturing technology process definition. ($3.5M)
- Established integrated environmental, safety, and health (ESH) objectives in all technical programs. ($19.0M)
- Executed a critical materials program investigating next generation substrate technologies. ($2.0M)
- Developed a productivity goal methodology, completing the analysis of three process flows from silicon-start through final packaging, ensuring continued improvement in overall capital productivity. ($0.5M)
- Initiated projects to place greater emphasis on back-end processes, such as packaging and test. ($1.5M)

(U) FY 1995 Program:

- Demonstrate full flow 0.25 micron pilot line-capable manufacturing technology. ($15.0M)
- Complete development of key equipments and unit processes to enable 0.25 micron semiconductor manufacturing. ($50.0M)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Semiconductor Manufacturing Technology,
BA 3 Advanced Development	PE 0603745E, Project EM-01

- Develop software tools and models that assist in the design of processes and equipment based on first-principles of physics. ($8.0M)
- Plan and begin technology development projects for 0.18 micron feature size generations. ($5.0M)
- Optimize materials, processes, and equipment for low contaminant, robust manufacturing. ($1.0M)
- Initiate projects to reduce the sensitivity of manufacturing cost to production volume. ($1.0M)
- Initiate projects in generic design tools that support advanced capabilities. ($1.0M)
- Demonstrate improved manufacturing tools and methods with enhanced Environmentally Safety Health (ESH) performance. ($9.0M)

(U) FY 1996 Program:
- Investigate mainstream process flows for 0.18 micron technology. ($20.0M)
- Initiate key improvement projects for critical manufacturing tools needed for 0.18 micron capabilities. ($50.0M)
- Complete integration of a software tool suite that supports rapid prototyping of advanced designs. ($5.0M)
- Optimize micro- and mini-environments for contamination-free manufacturing. ($6.0M)
- Demonstrate improved manufacturing tools and methods with enhanced ESH performance. ($9.0M)

(U) **Program Change Summary:**   *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	89.5	90.0	90.0	90.0
Current Budget	89.5	90.0	90.0	0

(U) **Change Summary Explanation:**

FY 1997   SEMATECH announced that the semiconductor industries' accomplishments of the last few years, now permit the member companies to plan for assuming full responsibility for SEMATECH's operational funding beginning in FY 1997.

(U) **Other Program Funding Summary Cost:**   N/A

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

	DATE:
	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Semiconductor Manufacturing Technology,
BA 3 Advanced Development	PE 0603745E, Project EM-01

(U) **Schedule Profile:**

Plan   **Milestones**

Dec 94   Transfer key unit processes and generic manufacturing methods for integration into production
                   facilities for 0.35 micron manufacturing.

Nov 95   Demonstrate generic design tools that support first-pass success and reduced design cycle times.

Dec 95   Complete full-flow 0.25 micron process technology development projects and transfer technology to
                   member companies.

Mar 96   Transfer software tool suites that support reduced development cycle times.

Jun 96   Demonstrate operation of key elements of a fully integrated advanced manufacturing system enabling
                   maximum flexibility and rapid response to process modifications.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: September 1994

| APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 6 RDT&E Management Support | | | | | | | R-1 ITEM NOMENCLATURE
Management Headquarters (R&D),
PE 0605898E | | |

COST *(In Thousands)*	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Cost to Complete	Total Cost
Management Headquarters MH-01	27,580	28,718	32,337	33,517	34,474	35,546	36,124	36,881	Continuing	Continuing

(U) **Mission Description:** This program element is budgeted in the Management Support Budget Activity because it provides funding for the administrative support costs of the Advanced Research Projects Agency. This funding provides for the personnel compensation and benefits for civilians as well as costs for building rent, physical and information security, travel, supplies and equipment, communications, printing and reproduction. In addition, funds are included for reimbursing the Military Services for administrative support costs associated with contracts undertaken on the Agency's behalf.

(U) **Program Accomplishments And Plans:**

(U) **FY 1994 Accomplishments:**

- Funding under this program element in FY 1994 supported management and administration for the RDT&E program assigned to ARPA. The majority of the funds were required for the pay of personnel who operate the Agency. The funding level reflects the rental costs associated with the expansion of office space, additional personnel provided by the FY 1994 Appropriation Act, and the related support requirements necessary to adequately execute the increased responsibilities assigned to the Agency. It also finances the ramp up to the additional end strength provided in FY 1995.

(U) **FY 1995 Program:**

- ARPA will continue the management and administrative support efforts for headquarters at an increased level over FY 1994. An additional 28 billets have been added to ARPA in FY 1995.

(U) **FY 1996 Program:**

- ARPA will continue the management and administrative support efforts for headquarters at approximately the same level as FY 1995.

(U) **FY 1997 Program:**

- ARPA will continue the management and administrative support efforts for headquarters at approximately the same level as FY 1996.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE	September 1994

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE
RDT&E, Defensewide	Management Headquarters (R&D),
BA 6 RDT&E Management Support	PE 0605898E, Project MH-01

(U) **Program Change Summary:** *(In Millions)*

	FY 1994	FY 1995	FY 1996	FY 1997
President's Budget	26.3	28.7	29.6	30.3
Current Budget	27.5	28.7	32.3	33.5

(U) **Change Summary Explanation:**

FY 1994   Increase reflects increased costs associated with the lease, buildout and furniture for an additional floor of the Arlington, VA Headquarters building.

FY 1996-97   Increase of $2.7 million and $3.2 million respectively reflects annualization of the FY 1994-95 billet increases, related travel requirements, and building lease costs.

(U) **Other Program Funding Summary Cost:**   N/A

(U) **Schedule Profile:**   N/A

SECTION III

MANPOWER

ADVANCED RESEARCH PROJECTS AGENCY
FY 1996/FY 1997 DEFENSE BUDGET SUBMISSION

SCHEDULE OF CIVILIAN AND MILITARY PERSONNEL

	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
I. CIVILIAN PERSONNEL								
RDT&E Defensewide US Direct Hire	152	182	182	182	182	182	176	172
Intergovermental Personnel Act (IPA)	35	35	35	35	35	35	35	35
Total, RDT&E	187	217	217	217	217	217	211	207
II. ACTIVE MILITARY PERSONNEL								
Officer, Army	3	3	3	3	3	3	3	3
Officer, Navy	4	4	4	4	4	4	4	4
Officer, Air Force	15	11	11	11	11	11	11	11
Enlisted, Air Force	0	1	1	1	1	1	1	1
Total Air Force	15	12	12	12	12	12	12	12
Total Military	22	19	19	19	19	19	19	19
TOTAL	209	236	236	236	236	236	230	226

Exhibit PB-4
September, 1994

ADVANCED RESEARCH PROJECTS AGENCY

ANALYSIS OF PAY INCREASE COSTS

FISCAL YEAR 1995

(Thousands of Dollars)

| Organizational Unit and Account Title | Increase in Direct Pay and Other Related Costs | | | Payments To ( ) | Reimbursements From ( ) | Net Cost | Gross Absorption Within Available Funds | Additional Appropriation Required |
	Direct Pay	Related Costs	Total Cost					
RDT&E, Defensewide								
Civilian Personnel Classified	140	24	164	0	0	164	164	0
Total	140	24	164	0	0	164	164	0

DEPARTMENT OF DEFENSE
ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL BUDGET CALCULATION
FY 1996/FY 1997 DEFENSE BUDGET SUBMISSION
Fiscal Year 1994

	Full-Time Equivalent End Strength	Work Years	In thousands of dollars			
			Compensation O.C. 11	Benefits O.C. 12	Total Compensation	Average Compensation
SUMMARY						
Direct Hire Civilians, United States:						
Classified and administrative	152	146	10492	1679	12171	83.36
Other:						
Intergovernmental Personnel Act (IPA)	35	26.5	3570	0	3570	134.72
Total United States	187	172.5	14062	1679	15741	91.25
Total Civilian Personnel Costs	187	172.5	14062	1679	15741	91.25
RDT&E Defensewide						
Direct Hire Civilians, United States:						
Classified and administrative	152	146	10492	1679	12171	83.36
Other:						
Intergovernmental Personnel Act (IPA)	35	26.5	3570	0	3570	134.72
Total United States	187	172.5	14062	1679	15741	91.25

EXHIBIT PB 31-R
SEPTEMBER 1994

DEPARTMENT OF DEFENSE
ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL BUDGET CALCULATION
FY 1996/FY 1997 DEFENSE BUDGET SUBMISSION
Fiscal Year 1995

	Full-Time Equivalent End Strength	Work Years	In thousands of dollars			Average Compensation
			Compensation O.C. 11	Benefits O.C. 12	Total Compensation	
SUMMARY						
Direct Hire Civilians, United States:						
Classified and administrative	182	168	12229	1965	14194	84.49
Other:						
Intergovernmental Personnel Act (IPA)	35	35	4970	0	4970	142.00
Total United States	217	203	17199	1965	19164	94.40
Total Civilian Personnel Costs	217	203	17199	1965	19164	94.40
RDT&E Defensewide						
Direct Hire Civilians, United States:						
Classified and administrative	182	168	12229	1965	14194	84.49
Other:						
Intergovernmental Personnel Act (IPA)	35	35	4970	0	4970	142.00
Total United States	217	203	17199	1955	19164	94.40

EXHIBIT PB 31-R
SEPTEMBER 1994

DEPARTMENT OF DEFENSE
ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL BUDGET CALCULATION
FY 1996/FY 1997 DEFENSE BUDGET SUBMISSION
Fiscal Year 1996

	Full-Time Equivalent End Strength	Work Years	In thousands of dollars				Average Compensation
			Compensation O.C. 11	Benefits O.C. 12	Total Compensation	
SUMMARY						
Direct Hire Civilians, United States:						
Classified and administrative	182	175	12958	2084	15042	85.95
Other:						
Intergovernmental Personnel Act (IPA)	35	35	5215	0	5215	149.00
Total United States	217	210	18173	2084	20257	96.46
Total Civilian Personnel Costs	217	210	18173	2084	20257	96.46
RDT&E Defensewide						
Direct Hire Civilians, United States:						
Classified and administrative	182	175	12958	2084	15042	85.95
Other:						
Intergovernmental Personnel Act (IPA)	35	35	5215	0	5215	149.00
Total United States	217	210	18173	2084	20257	96.46

EXHIBIT PB 31-R
SEPTEMBER 1994

DEPARTMENT OF DEFENSE
ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL BUDGET CALCULATION
FY 1996/FY 1997 DEFENSE BUDGET SUBMISSION
Fiscal Year 1997

SUMMARY	Full-Time Equivalent End Strength	Work Years	In thousands of dollars			Average Compensation
			Compensation O.C. 11	Benefits O.C. 12	Total Compensation	
Direct Hire Civilians, United States:						
Classified and administrative	182	175	13335	2157	15492	88.53
Other:						
Intergovernmental Personnel Act (IPA)	35	35	5495	0	5495	157.00
Total United States	217	210	18830	2157	20987	99.94
Total Civilian Personnel Costs	217	210	18830	2157	20987	99.94
RDT&E Defensewide						
Direct Hire Civilians, United States:						
Classified and administrative	182	175	13335	2157	15492	88.53
Other:						
Intergovernmental Personnel Act (IPA)	35	35	5495	0	5495	157.00
Total United States	217	210	18830	2157	20987	99.94

EXHIBIT PB 31-R
SEPTEMBER 1994

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ADVANCED RESEARCH PROJECTS AGENCY

FY 1996/FY 1997 DEFENSE BUDGET SUBMISSION

BUDGETED MILITARY AND CIVILIAN PAY RAISE AMOUNTS

($ in Thousands)

		FY 1995	FY 1996	FY 1997
MILITARY PERSONNEL	N/A	0	0	0

CIVILIAN PERSONNEL
RDT&E Defensewide
Classified

	Effective	Percent	FY 1995	FY 1996	FY 1997
FY 1995	1-Jan-95	1.6%	164	219	219
FY 1996	1-Jan-96	2.2%	0	239	319
FY 1997	1-Jan-97	2.5%	0	0	280
Total			164	458	818

	FY 1995	FY 1996	FY 1997
TOTAL PERSONNEL	164	458	818

Exhibit PB-53
September 1994

ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL COSTS
FY 1996/FY 1997 DEFENSE BUDGET SUBMISSION
FY 1994/95/96/97
($ in Thousands)

DATE: September 1994

APPROPRIATION: RESEARCH AND DEVELOPMENT

OP-08 Civilian Personnel

Prior Year (PY) = 1994

DP TRES OO LN IT	DESCRIPTION	PY BEGIN STRENGTH	PY END STRENGTH TOTAL	PY END STRENGTH FTP	WORK YEARS TOTAL	WORK YEARS FTP	PY BASIC COMP	PY OVER TIME	PY HOL PREM	PY OTHER OC 11	PY TOTAL VARIAB	PY TOTAL OC 11	PY BENEFIT OC 12	PY TOTAL COST
400 50 1	Senior Executive Schedule	22	25	21	21	20	2303	0	0	98	98	2401	385	2786
400 50 3	General Schedule	115	132	131	125	122	7750	50	1	290	341	8091	1294	9385
400 50	Subtotal	137	157	152	146	142	10053	50	1	388	439	10492	1679	12171
400 50	Subtotal (Rate)						68.85616				0.04367	71.86301	0.16'01	83.36301
400 50 4	Special Schedule (IPA)	17	30	35	26.5	26.5	3570					3570		3570
400 50	IPA (Rate)						134.71698					134.71698		134.71698
400 50	Total Civilian	154	187	187	172.5	168.5	13623	50	1	388	439	14062	1679	15741
400 50	Total Civilian (Rate)						78.97391				0.03222	81.51884	0.12325	91.25217

ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL COSTS
FY 1996/FY 1997 DEFENSE BUDGET SUBMISSION
FY 1994/95/96/97
($ in Thousands)

APPROPRIATION: RESEARCH AND DEVELOPMENT

DATE: September 1994

OP-08 Civilian Personnel

Current Year (CY) = 1995

DP LN IPES OO II	DESCRIPTION	CY BEGIN STRENGTH	CY END STRENGTH TOTAL	CY END STRENGTH FTP	WORK YEARS TOTAL	WORK YEARS FTP	CY BASIC COMP	CY OVER TIME	CY HOL PREM	CY OTHER OC 11	CY TOTAL VARIAB	CY TOTAL OC 11	CY BENEFIT OC 12	CY TOTAL COST
400 50	1 Senior Executive Schedule	21	25	25	23	22	2563	0	0	110	110	2673	432	3105
400 50	3 General Schedule	131	157	157	145	143	9134	55	2	350	407	9541	1548	11089
400 50	Subtotal	152	182	182	168	165	11697	55	2	460	517	12214	1980	14194
400 50	Subtotal (Rate)						69.62500				0.04420	72.70238	0.16927	84.48810
400 50	4 Special Schedule (IPA)	35	35	35	35	35	4970					4970		4970
400 50	IPA (Rate)						142.00000					142.00000		142.00000
400 50	Total Civilian	187	217	217	203	200	16667	55	2	460	517	17184	1980	19164
400 50	Total Civilian (Rate)						82.10345				0.04420	84.65025	0.11880	94.40394

ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL COSTS
FY 1996/FY 1997 DEFENSE BUDGET SUBMISSION
FY 1994/95/96/97
($ in Thousands)

DATE: September 1994

APPROPRIATION: RESEARCH AND DEVELOPMENT

OP-08 Civilian Personnel

Budget Year Plus One (BY1) = 1996

DP LN ITES OO II	DESCRIPTION	BY BEGIN STRENGTH	BY1 END STRENGTH TOTAL	FTP	WORK YEARS TOTAL	FTP	BY1 BASIC COMP	BY1 OVER TIME	BY1 HOL PREM	BY1 OTHER OC 11	BY1 TOTAL VARIAB	BY1 TOTAL OC 11	BY1 BENEFIT OC 12	BY1 TOTAL COST
400 50	1 Senior Executive Schedule	25	25	25	23	22	2619	0	0	117	117	2736	442	3178
400 50	3 General Schedule	157	157	157	152	150	9786	60	4	357	421	10207	1657	11864
400 50	Subtotal	182	182	182	175	172	12405	60	4	474	538	12943	2099	15042
400 50	Subtotal (Rate)						70.88571				0.04337	73.96000	0.16921	85.95429
400 50	4 Special Schedule (IPA)	35	35	35	35	35	5215					5215		5215
400 50	IPA (Rate)						149.00000					149.00000		149.00000
400 50	Total Civilian	217	217	217	210	207	17620	60	4	474	538	18158	2099	20257
400 50	Total Civilian (Rate)						83.90476				0.04337	86.46667	0.11913	96.46190

ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL COSTS
FY 1996/FY 1997 DEFENSE BUDGET SUBMISSION
FY 1994/95/96/97
($ in Thousands)

DATE: September 1994

APPROPRIATION: RESEARCH AND DEVELOPMENT

OP-08 Civilian Personnel

Budget Year Plus Two (BY2) = 1997

DP LN TRES CC II	DESCRIPTION	BY BEGIN STRENGTH	BY2 END STRENGTH TOTAL	FTP	WORK YEARS TOTAL	FTP	BY2 BASIC COMP	BY2 OVER TIME	BY2 HOL PREM	BY2 OTHER OC 11	BY2 TOTAL VARIAB	BY2 TOTAL OC 11	BY2 BENEFIT OC 12	BY2 TOTAL COST
400 50	1 Senior Executive Schedule	25	25	25	23	22	2802	0	0	127	127	2929	476	3405
400 50	3 General Schedule	157	157	157	152	150	9964	65	6	356	427	10391	1696	12087
400 50	Subtotal	182	182	182	175	172	12766	65	6	483	554	13320	2172	15492
400 50	Subtotal (Rate)						72.94857				0.04340	76.11429	0.17014	88.52571
400 50	4 Special Schedule (IPA)	35	35	35	35	35	5495					5495		5495
400 50	IPA (Rate)						157.00000					157.00000		157.00000
400 50	Total Civilian	217	217	217	210	207	18261	65	6	483	554	18815	2172	20987
400 50	Total Civilian (Rate)						86.95714				0.04340	89.59524	0.11894	99.93810

ADVANCED RESEARCH PROJECTS AGENCY
Civilian Personnel Workyear Report

	FY 1994 Est Act	FY 1995 Est	FY 1996 Est	FY 1997 Est	FY 1998 Est	FY 1999 Est	FY 2000 Est	FY 2001 Est
RDT&E DEFENSEWIDE								
Straight Time Workyears:	172.5	203	210	210	210	210	204	200
DIRECT FUNDED:								
US - Direct Hire	172.5	203	210	210	210	210	204	200
Total Direct Hire	172.5	203	210	210	210	210	204	200
Total DIRECT FUNDED Workyears	172.5	203	210	210	210	210	204	200

SECTION IV

OTHER REQUIRED EXHIBITS

CONSULTING SERVICES

PB-15 Exhibit

ADVANCED RESEARCH PROJECTS AGENCY

Appropriation: RDT&E Defensewide

(Dollars in Thousands)

		FY 1994	FY 1995	FY 1996
I.	Management & Professional Support Services	35,197	35,500	37,000
II.	Studies, Analysis, & Evaluations	8,303	8,500	8,800
III.	Engineering & Technical Services	0	0	0
	Totals	43,500	44,000	45,800

MANAGEMENT HEADQUARTERS

ADVANCED RESEARCH PROJECTS AGENCY

	FY 1994 Actual				FY 1995 Estimate				FY 1996 Estimate				FY 1997 Estimate			
	Mil ES	Civ ES	Tot ES	Total Oblig	Mil ES	Civ ES	Tot ES	Total Oblig	Mil ES	Civ ES	Tot ES	Total Oblig	Mil ES	Civ ES	Tot ES	Total Oblig
Departmental Activities																
Military Services																
Military																
U.S. Army	3		3	207	3		3	206	3		3	206	3		3	208
U.S. Navy	4		4	293	4		4	301	4		4	300	4		4	309
U.S. Air Force	15		15	1,050	12		12	966	12		12	853	12		12	861
			22	1,550			19	1,473			19	1,359			19	1,378
Defense Agencies																
RDT&E Defensewide																
Civilian																
U.S. Direct Hire		152	152	12,171		182	182	14,194		182	182	15,042		182	182	15,492
IPA's			35	3,570			35	4,970			35	5,215			35	5,495
Other Costs				11,839				9,554				12,080				12,530
			187	27,580			217	28,718			217	32,337			217	33,517
TOTAL END STRENGTH			209				236				236				236	

(Dollars in Thousands; End Strengths in Whole Numbers)

Advanced Research Projects Agency
SUMMARY OF FUNDS BUDGETED FOR ENVIRONMENTAL PROJECTS
FY 1996/FY 1997 BUDGET

($ in Thousands)

Environmental Programs	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate	Change FY 95/96	Change FY 96/97
Environmental Cleanup	Not Applicable					
Environmental Compliance	Not Applicable					
Environmental Conservation	Not Applicable					
Pollution Prevention	Not Applicable					
Environmental Technology						
Appropriation: RDT&E Defensewide						
Conservation						
Coal Utilization	5,000					
Earth Conservancy	10,000					
Nuclear Waste Monitoring	250					
Pollution Prevention						
Supercritical Fluid Technology	2,349	725			-725	
Hazardous Waste Management	8,000					
Technology for a Sustainable Future	50					
Environmental Super Critical Water Oxidation		7,000	7,598	7,801	+598	+203
Joint Casting Emissions Reduction	13,500					
Environmental Green		3,100	4,558	7,900	+1,458	+3,342
Fire Protection Technology	250					
Environmentally Conscious Elec Sys Mfg.	20,000					
CFC Free Manufacturing (Sematech)	14,000	13,000	13,000		0	-13,000
Base Realignment and Closure	Not Applicable					
Grand Total	73,399	23,825	25,156	15,701		

Justification for Changes

The outyear funding changes reflect normal funding profiles relative to work being performed during the respective fiscal years and fund availability approved for the efforts.

The Sematech grant is being discontinued in FY 1997.

Exhibit PB-28 (page 1 of 2)

Advanced Resear 'rojects Agency

SUMMARY OF FUNDS BUDGETED FOR ENVIRONMENTAL PROJECTS

FY 1996/FY 1997 BUDGET

($ in Thousands)

	FY 1998	FY 1999	FY 2000	FY 2001
Environmental Programs				
Environmental Cleanup	Not Applicable			
Environmental Compliance	Not Applicable			
Environmental Conservation	Not Applicable			
Pollution Prevention	Not Applicable			
Environmental Technology				
Appropriation: RDT&E Defensewide				
Conservation				
Coal Utilization				
Earth Conservancy				
Nuclear Waste Monitoring				
Pollution Prevention				
Supercritical Fluid Technology				
Hazardous Waste Management				
Technology for a Sustainable Future				
Environmental Super Critical Water Oxidation				
Joint Casting Emissions Reduction				
Environmental Green	11,900	12,000	0	0
Fire Protection Technology				
Environmentally Conscious Elec Sys Mfg.				
CFC Free Manufacturing (Sematech)				
Base Realignment and Closure	Not Applicable			
Grand Total	11,900	12,000	0	0

DoD Aeronautical Budget
Advanced Research Projects Agency

($ in Thousands)

Appropriation Summary:

	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate
Research, Development, Test and Evaluation, Defensewide	38,370	57,014	55,887	96,175

Program Data:

Program Element	FY 1994 Actual	FY 1995 Estimate	FY 1996 Estimate	FY 1997 Estimate
Aeronautics Technology	0602702E	12,658	0	0	0
ASTOVL/COTL	0603226E	25,712	20,014	30,887	81,440
Tier III	0603226E	0	37,000	25,000	14,775

Exhibit PB-52A DoD Aeronautical Budget

DoD Space Budget
Advanced Research Projects Agency

($ in Thousands)

Appropriation Summary:

<u>Appropriation</u>

	<u>FY 1994</u>	<u>FY 1995</u>	<u>FY 1996</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999-2000</u>
Research, Development, Test & Evaluation, Defensewide	68,662	5,925	0	0	0	0

Program Data:

Program Title	Program Element	Approp Code	Factor	Category	<u>FY 1994</u>	<u>FY 1995</u>	<u>FY 1996</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999-2000</u>
Advanced Space Technology	0603226E	RDT&E,DA	100%	Comm	13,742	5,925	0	0	0	0
				Launch Vehicle	49,393					
				Support RDT&E	5,527					

Exhibit PB-52B DoD Space Budget

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DEPARTMENT OF DEFENSE
ADVANCED RESEARCH PROJECTS AGENCY (ARPA)
FY 1995 BUDGET ESTIMATES
EXECUTIVE SUMMARY ON INFORMATION TECHNOLOGY

1. **Activities**: Information technology (IT) activities provide
direct support to a total agency staff of approximately two
hundred personnel engaged in making research investments in new
technologies considered to be critical to the nation's defense.
ARPA IT support is provided for the functions of office automation
and decision support. These functions accomplish four IT goals:
(1) to provide products for externally required reporting (e.g.,
Defense budget input); (2) to support internal management
processes (e.g., research investment strategy decisions); (3) to
provide an in-house base for various information system research
prototypes, and (4) to provide an efficient and effective work
environment. ARPA IT is viewed as three inter-linked systems
providing this functional support: Desktop Automation, Central
Processing, and Network Communications. Desktop Automation
provides office desktop tools such as word processing,
spreadsheets, and presentation graphics. Central Processing
provides the presentation of DFAS data through both an executive
information system and through data manipulation software. It
also provides other local information to support administrative
processes such as the handling of ARPA funding documents prior to
entering the DFAS system, National Science Foundation and external
reporting requirements, internal management requirements, and
internal management controls. Network Communications provides
productivity products such as electronic mail, centralized
calendaring and management of meetings, and on-line access to
policy, forms, and historic data. The Network further provides
both the linking of internal systems and access to external
communications such as the Defense Data Network.

2. **Initiatives**: The most significant influences on the estimates
for the budget year are staff increases and general IT evolution.
This evolution includes technology upgrades in all systems to
maintain an optimal balance between functional expansion and
expenditures. The goal of that balance is to maximize staff
productivity and work-quality gains without exceeding the point at
which marginal gains no longer produce a positive return on
investment. The budget estimates also reflect the recognition
that sufficient resources must be directed toward
development/modernization (D/M). The Agency planning process
ensures that resources are directed toward D/M at the earliest
point at which the benefit from D/M exceeds the benefit from
operations/maintenance. This balancing process maximizes staff
productivity.

3. **Changes**: No significant changes (± 30%) have occurred.

ADVANCED RESEARCH PROJECTS AGENCY
REPORT ON INFORMATION TECHNOLOGY (IT) RESOURCES
BUDGET ESTIMATES SUBMISSION
(Dollars in Thousands)

			FY94	FY95	FY96	FY97
1.		Equipment ($000)				
	A.	Capital Purchases (>$15,000)	2031	2088	2148	2274
	B.	Purchases/leases (≤ $15,000)	0	0	0	0
		Subtotal	2031	2088	2148	2274
2.		Software ($000)				
	A.	Capital Purchases (>$15,000)	0	0	0	0
	B.	Purchases/leases (≤ $15,000)	364	374	385	408
		Subtotal	364	374	385	408
3.		Services ($000)				
	A.	Communications	0	0	0	0
	B.	Processing	0	0	0	0
	C.	Other	0	0	0	0
		Subtotal	0	0	0	0
4.		Support Services ($000)				
	A.	Software	1024	1053	1083	1147
	B.	Equipment Maintenance	373	383	394	418
	C.	Other	2178	2306	2372	2512
		Subtotal	3575	3742	3850	4077
5.		Supplies ($000)	34	35	36	38
6.		Personnel (Compensation, Benefits) ($000)				
	A.	Software	0	0	0	0
	B.	Processing	0	0	0	0
	C.	Other	425	431	442	452
		Subtotal	425	431	442	452
7.		Other (Non-FIP Resources) ($000)				
	A.	Capital Purchases (>$15,000)	0	0	0	0
	B.	Purchases/leases (≤ $15,000)	31	32	33	35
		Subtotal	31	32	33	35
8.		Intra-Governmental Payments ($000)				
	A.	Software	0	0	0	0
	B.	Equipment Maintenance	0	0	0	0
	C.	Processing	0	0	0	0
	D.	Communications	200	206	212	224
	E.	Other	0	0	0	0
		Subtotal	200	206	212	224
8.		Intra-Governmental Collections ($000)				
	A.	Software	0	0	0	0
	B.	Equipment Maintenance	0	0	0	0
	C.	Processing	0	0	0	0
	D.	Communications	0	0	0	0
	E.	Other	0	0	0	0
		Subtotal	0	0	0	0
		NET IT RESOURCES (sum 1-9 above)	6660	6908	7104	7508
		Workyears	5	5	5	5

Appropriation: All funding is RDT&E, Defensewide

Exhibit 43 Report on Information Technology Resources

ADVANCED RESEARCH PROJECTS AGENCY
INFORMATION TECHNOLOGY (IT) RESOURCES BY CIM FUNCTIONAL AREA
BUDGET ESTIMATES SUBMISSION
(Dollars in Thousands)

	FY94	FY95	FY96	FY97
A. Science and Technology				
1. Major Systems/Initiatives	0	0	0	0
2. Non Major Systems/Initiatives	0	0	0	0
3. All Other				
Development/Modernization	3396	3453	3513	3639
Current Services	3264	3455	3591	3868
Subtotal	6660	6908	7104	7508
Appropriation/Fund - RDT&E, Defensewide				
4. TOTAL Science and Technology				
Total Development/Modernization	3396	3453	3513	3639
Total Current Services	3264	3455	3591	3868
Subtotal	6660	6908	7104	7508
Appropriation/Fund - RDT&E, Defensewide				
B. CIM Grand Total				
Development/Modernization	3396	3453	3513	3639
Current Services	3264	3455	3591	3868
Subtotal	6660	6908	7104	7508
Appropriation/Fund - RDT&E, Defensewide				

Exhibit 43(IT-1) Report on Information Technology Resources

RESEARCH AND DEVELOPMENT ACTIVITIES
OMB EXHIBIT 44A WORKSHEET
FY 1996 DEFENSE BUDGET ESTIMATES
(in thousands of dollars)

DoD Component: Advanced Research Projects Agency   **DATE: September 9, 1994**

SECTION 1 - SUMMARY OF R & D COSTS

1A - R & D Costs in RDT&E Appropriations

		FY 1994	FY 1995	FY 1996	FY 1997
1A1 - Basic Research (6.1)	B.A.	85,889	87,554	90,352	93,064
	Outlays	77,086	84,635	88,004	92,016
1A2 - Applied Research (6.2)	B.A.	756,933	823,881	796,871	802,554
	Outlays	677,423	795,059	773,370	801,114
1A3 - Development (6.3)	B.A.	1,784,245	1,750,251	1,827,977	1,820,123
	Outlays	1,581,434	1,685,012	1,805,418	1,813,215
Subtotal for 1A	*B.A.*	2,627,067	2,661,686	2,715,200	2,715,741
	Outlays	2,335,943	2,564,706	2,666,792	2,706,345

1B - R & D Costs in Other Appropriations
Not Applicable

		FY 1994	FY 1995	FY 1996	FY 1997
TOTAL SECTION 1	***B.A.***	2,627,067	2,661,686	2,717,200	2,715,741
	Outlays	2,335,943	2,564,706	2,666,792	2,706,345

SECTION 2 - DISTRIBUTION BY PERFORMER

		FY 1994	FY 1995	FY 1996	FY 1997
2A - In House Activity	B.A.	288,977	292,785	298,672	298,732
2B - Private Industry	B.A.	1,471,158	1,490,545	1,520,512	1,520,815
2C - Colleges/University	B.A.	394,060	399,253	407,280	407,361
2D - Other Non-Profit	B.A.	472,872	479,103	488,736	488,833
TOTAL SECTION 2	***B.A.***	2,627,067	2,661,686	2,715,200	2,715,741

SECTION 3 - COLLEGE AND UNIVERSITY DATA

		FY 1994	FY 1995	FY 1996	FY 1997
3A - Total College and	B.A.	394,060	399,253	407,280	407,361
University Funding	Outlays	357,412	362,122	369,403	369,476
3B - Indirect Costs At Colleges	B.A.	Not Available			
and Universities	Outlays				

SECTION 4 - PEER REVIEW DATA
Not Available

Name: Larry McIlhenny
Tel: (703) 696-2391

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-1, Physical Security)

MANPOWER

	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel								
a. Officers								
End Strength	0	0	0	0	0	0	0	0
Average Strength	0	0	0	0	0	0	0	0
b. Enlisted								
End Strength	0	0	0	0	0	0	0	0
Average Strength	0	0	0	0	0	0	0	0
c. Total Military								
End Strength	0	0	0	0	0	0	0	0
Average Strength	0	0	0	0	0	0	0	0
Civilian Personnel								
a. Direct Hire								
End Strength	1	1	1	1	1	1	1	1
Workyears	0	0	0	0	0	0	0	0
b. Indirect Hire								
End Strength	1	1	1	1	1	1	1	1
Workyears	1	1	1	1	1	1	1	1
c. Total DoD Civilians								
End Strength	1	1	1	1	1	1	1	1
Workyears	1	1	1	1	1	1	1	1
TOTAL DOD MANPOWER								
End Strength	1	1	1	1	1	1	1	1
Contract Personnel								
Workyears	1	1	1	1	1	1	1	1

Exhibits SA-1 (Page 1 of 3)

ADVANCED RESEARCH PROJECTS AGENCY

SECURITY ACTIVITIES (SA-1, Physical Security)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS						
a. Personnel						
(1) Military (Active)						
(2) Military (National Guard)						
(3) Military (Reserve)						
(4) O&M, Active						
(5) O&M, National Guard						
(6) O&M, Reserve						
(7) Other - PE 0605898E						
(a) Direct Hire, Civilian	.054	.056	.058	.060	.063	.065
(b) Contract	.062	.064	.066	.069	.072	.075
Subtotal Personnel Costs	.116	.120	.124	.129	.135	.140
b. Security Equipment						
(1) O&M, Active						
(2) O&M, National Guard						
(3) O&M, Reserve						
(4) Other - PE 0605898E	.149	.151	.130	.047	.042	.043
Subtotal Security Equipment Costs	.149	.151	.130	.047	.042	.043
c. Miscellaneous	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.265	.271	.254	.176	.177	.183

Exhibits SA-1   (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-1, Physical Security)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS						
a. Security Equipment						
(1) Other Procurement						
(2) O&M, Active						
(3) O&M, National Guard						
(4) O&M, Reserve						
(5) Defense Business Operations Funds						
(6) Other						
Subtotal Security Equipment	0	0	0	0	0	0
b. Security RDT&E, Defensewide						
(1) 6.1 (Research)						
(2) 6.2 (Exploratory Development)						
(3) 6.3 (Advanced Development)						
(4) 6.4 (Engineering Development)						
(5) 6.5 (Management & Support)						
Subtotal Security RDT&E	0	0	0	0	0	0
c. Security Construction						
(1) Military Construction appropriation						
(2) O&M appropriation						
Subtotal Security Construction	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	0	0	0	0	0	0
TOTAL TOA FOR ARPA	.265	.271	.254	.276	.277	.283

Exhibit SA-1 (Page 3 of 3)

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ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-2, Classified Management Security)

MANPOWER

	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel								
a. Officers								
End Strength	0	0	0	0	0	0	0	0
Average Strength								
b. Enlisted								
End Strength	0	0	0	0	0	0	0	0
Average Strength								
c. Total Military								
End Strength	0	0	0	0	0	0	0	0
Average Strength								
Civilian Personnel								
a. Direct Hire								
End Strength	1	1	1	1	1	1	1	1
Workyears								
b. Indirect Hire								
End Strength	0	0	0	0	0	0	0	0
Workyears								
c. Total DoD Civilians								
End Strength	1	1	1	1	1	1	1	1
Workyears								
TOTAL DOD MANPOWER								
End Strength	1	1	1	1	1	1	1	1
Contract Personnel								
Workyears	3	3	3	3	3	3	3	3

Exhibits SA-2 (Page 1 of 3)

ADVANCED RESEARCH PROJECTS AGENCY

SECURITY ACTIVITIES (SA-2, Classified Management Security)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	(FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS						
a. Personnel						
(1) Military (Active)						
(2) Military (National Guard)						
(3) Military (Reserve)						
(4) O&M, Active						
(5) O&M, National Guard						
(6) O&M, Reserve						
(7) Other - PE 0605898E						
(a) Direct Hire, Civilian	.054	.056	.053	.060	.063	.065
(b) Contract	.186	.192	.198	.207	.216	.225
Subtotal Personnel Costs	.240	.248	.256	.267	.279	.290
b. Security Equipment						
(1) O&M, Active						
(2) O&M, National Guard						
(3) O&M, Reserve						
(4) Other						
Subtotal Security Equipment Cost	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.240	.248	.256	.267	.279	.290

Exhibits SA-2   (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY

SECURITY ACTIVITIES (SA-2, Classified Management Security)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS						
a. Security Equipment						
(1) Other Procurement						
(2) O&M, Active						
(3) O&M, National Guard						
(4) O&M, Reserve						
(5) Defense Business Operations Funds						
(6) Other (Specifically identify each applicable appropriation/account)						
Subtotal Security Equipment	0	0	0	0	0	0
b. Security RDT&E, Defensewide						
(1) 6.1 (Research)						
(2) 6.2 (Exploratory Development)						
(3) 6.3 (Advanced Development)						
(4) 6.4 (Engineering Development)						
(5) 6.5 (Management & Support)						
Subtotal Security RDT&E	0	0	0	0	0	0
c. Security Construction						
(1) Military Construction appropriation						
(2) O&M appropriation	0	0	0	0	0	0
Subtotal Security Construction	0	0	0	0	0	0
TOTAL INVESTMENTS COSTS	0	0	0	0	0	0
TOTAL TOA FOR ARPA	.240	.248	.256	.267	.279	.290

Exhibit SA-2 (Page 3 of 3)

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ADVANCED RESEARCH PROJECTS AGENCY

SECURITY ACTIVITIES (SA-3, Communications Security)

MANPOWER

	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel								
a. Officers								
End Strength	0	0	0	0	0	0	0	0
Average Strength								
b. Enlisted								
End Strength	0	0	0	0	0	0	0	0
Average Strength								
c. Total Military								
End Strength	0	0	0	0	0	0	0	0
Average Strength								
Civilian Personnel								
a. Direct Hire								
End Strength	1	1	1	1	1	1	1	1
Workyears								
b. Indirect Hire								
End Strength	0	0	0	0	0	0	0	0
Workyears								
c. Total DoD Civilians								
End Strength	1	1	1	1	1	1	1	1
Workyears								
TOTAL DOD MANPOWER								
End Strength	1	1	1	1	1	1	1	1
Contract Personnel								
Workyears	0	0	0	0	0	0	0	0

ADVANCED RESEARCH PROJECTS AGENCY

SECURITY ACTIVITIES (SA-3, Communications Security)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS						
a. Personnel						
(1) Military (Active)						
(2) Military (National Guard)						
(3) Military (Reserve)						
(4) O&M, Active						
(5) O&M, National Guard						
(6) O&M, Reserve						
(7) Other - PE 0605898E						
(a) Direct Hire, Civilian	.054	.056	.058	.060	.063	.065
(b) Contract	0	0	0	0	0	0
Subtotal Personnel Costs	.054	.056	.058	.060	.063	.065
b. Security Equipment						
(1) O&M, Active						
(2) O&M, National Guard						
(3) O&M, Reserve						
(4) Other						
Subtotal Security Equipment Cost	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.054	.056	.058	.060	.063	.065

Exhibits SA-3 (Page 2 of 3)

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ADVANCED RESEARCH PROJECTS AGENCY

SECURITY ACTIVITIES (SA-3, Communications Security)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS						
a. Security Equipment						
(1) Other Procurement						
(2) O&M, Active						
(3) O&M, National Guard						
(4) O&M, Reserve						
(5) Defense Business Operations Funds						
(Asset Capitalization Program Only)						
(6) Other	0	0	0	0	0	0
Subtotal Security Equipment						
b. Security RDT&E, Defensewide						
(1) 6.1 (Research)						
(2) 6.2 (Exploratory Development)						
(3) 6.3 (Advanced Development)						
(4) 6.4 (Engineering Development)						
(5) 6.5 (Management & Support)						
Subtotal Security RDT&E	0	0	0	0	0	0
c. Security Construction						
(1) Military Construction appropriation						
(2) O&M appropriation	0	0	0	0	0	0
Subtotal Security Construction	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	.054	.056	.058	.060	.063	.065
TOTAL TOA FOR ARPA						

Exhibit SA-3 (Page 3 of 3)

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ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-4, Automated Information Systems)

MANPOWER

	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel								
a. Officers								
End Strength	0	0	0	0	0	0	0	0
Average Strength	0	0	0	0	0	0	0	0
b. Enlisted								
End Strength	0	0	0	0	0	0	0	0
Average Strength	0	0	0	0	0	0	0	0
c. Total Military								
End Strength	0	0	0	0	0	0	0	0
Average Strength								
Civilian Personnel								
a. Direct Hire								
End Strength	0	0	0	0	0	0	0	0
Workyears	0	0	0	0	0	0	0	0
b. Indirect Hire								
End Strength	0	0	0	0	0	0	0	0
Workyears	0	0	0	0	0	0	0	0
c. Total DoD Civilians								
End Strength	0	0	0	0	0	0	0	0
Workyears								
TOTAL DOD MANPOWER								
End Strength	0	0	0	0	0	0	0	0
Contract Personnel								
Workyears	1	1	1	1	1	1	1	1

ADVANCED RESEARCH PROJECTS AGENCY

SECURITY ACTIVITIES (SA-4, Automated Information Systems)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS						
a. Personnel						
(1) Military (Active)						
(2) Military (National Guard)						
(3) Military (Reserve)						
(4) O&M, Active						
(5) O&M, National Guard						
(6) O&M, Reserve						
(7) Other - PE 0605898E	0	0	0	0	0	0
(a) Direct Hire, Civilian	.062	.064	.066	.069	.072	.075
(b) Contract	.062	.064	.066	.069	.072	.075
Subtotal Personnel Costs						
b. Security Equipment						
(1) O&M, Active						
(2) O&M, National Guard						
(3) O&M, Reserve						
(4) Other	0	0	0	0	0	0
Subtotal Security Equipment Cost						
c. Miscellaneous	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.062	.064	.066	.069	.072	.075

Exhibits SA-4 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY

SECURITY ACTIVITIES (SA-4, Automated Information Systems)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS						
a. Security Equipment						
(1) Other Procurement						
(2) O&M, Active						
(3) O&M, National Guard						
(4) O&M, Reserve						
(5) Defense Business Operations Funds						
(6) Other						
Subtotal Security Equipment	0	0	0	0	0	0
b. Security RDT&E, Defensewide						
(1) 6.1 (Research)						
(2) 6.2 (Exploratory Development)						
(3) 6.3 (Advanced Development)						
(4) 6.4 (Engineering Development)						
(5) 6.5 (Management & Support)						
Subtotal Security RDT&E	0	0	0	0	0	0
c. Security Construction						
(1) Military Construction appropriation						
(2) O&M appropriation	0	0	0	0	0	0
Subtotal Security Construction	0	0	0	0	0	0
TOTAL INVESTMENTS COSTS	0	0	0	0	0	0
TOTAL TOA FOR ARPA	.062	.064	.066	.069	.072	.075

Exhibit 8A-4 (Page 3 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-7, Personnel Security)

MANPOWER

	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel								
a. Officers								
End Strength	0	0	0	0	0	0	0	0
Average Strength								
b. Enlisted								
End Strength	0	0	0	0	0	0	0	0
Average Strength								
c. Total Military								
End Strength	0	0	0	0	0	0	0	0
Average Strength								
Civilian Personnel								
a. Direct Hire								
End Strength	1	1	1	1	1	1	1	1
Workyears								
b. Indirect Hire								
End Strength	0	0	0	0	0	0	0	0
Workyears								
c. Total DoD Civilians								
End Strength	1	1	1	1	1	1	1	1
Workyears								
TOTAL DOD MANPOWER								
End Strength	1	1	1	1	1	1	1	1
Contract Personnel								
Workyears	15	15	15	15	15	15	15	15

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ADVANCED RESEARCH PROJECTS AGENCY

SECURITY ACTIVITIES (SA-7, Personnel Security)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS						
a. Personnel						
(1) Military (Active)						
(2) Military (National Guard)						
(3) Military (Reserve)						
(4) O&M, Active						
(5) O&M, National Guard						
(6) O&M, Reserve						
(7) Other - PE 0605898E						
(a) Direct Hire, Civilian	.054	.056	.058	.060	.063	.065
(b) Contract	.930	.960	.990	1.035	1.080	1.125
Subtotal Personnel Costs	.984	1.016	1.048	1.095	1.143	1.190
b. Security Equipment						
(1) O&M, Active						
(2) O&M, National Guard						
(3) O&M, Reserve						
(4) Other (Specifically identify each applicable appropriation/account)						
Subtotal Security Equipment Cost	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.984	1.016	1.048	1.095	1.143	1.190

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-7, Personnel Security)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS						
a. Security Equipment						
(1) Other Procurement						
(2) O&M, Active						
(3) O&M, National Guard						
(4) O&M, Reserve						
(5) Defense Business Operations Funds						
(6) Other						
Subtotal Security Equipment	0	0	0	0	0	0
b. Security RDT&E, Defensewide						
(1) 6.1 (Research)						
(2) 6.2 (Exploratory Development)						
(3) 6.3 (Advanced Development)						
(4) 6.4 (Engineering Development)						
(5) 6.5 (Management & Support)						
Subtotal Security RDT&E	0	0	0	0	0	0
c. Security Construction						
(1) Military Construction appropriation						
(2) O&M appropriation						
Subtotal Security Construction	0	0	0	0	0	0
TOTAL INVESTMENTS COSTS	0	0	0	0	0	0
TOTAL TOA FOR ARPA	.984	1.016	1.048	1.095	1.143	1.190

ADVANCED RESEARCH PROJECTS AGENCY

SECURITY ACTIVITIES (SA-10, Special Access Programs Oversight)

MANPOWER

	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel								
a. Officers								
End Strength	0	0	0	0	0	0	0	0
Average Strength	0	0	0	0	0	0	0	0
b. Enlisted								
End Strength	0	0	0	0	0	0	0	0
Average Strength								
c. Total Military								
End Strength	0	0	0	0	0	0	0	0
Average Strength								
Civilian Personnel								
a. Direct Hire								
End Strength	2	2	2	2	2	2	2	2
Workyears								
b. Indirect Hire								
End Strength	0	0	0	0	0	0	0	0
Workyears								
c. Total DoD Civilians								
End Strength	2	2	2	2	2	2	2	2
Workyears								
TOTAL DOD MANPOWER								
End Strength	2	2	2	2	2	2	2	2
Contract Personnel								
Workyears	2	2	2	2	2	2	2	2

ADVANCED RESEARCH PROJECTS AGENCY

SECURITY ACTIVITIES (SA-10, Special Access Programs Oversight)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS						
a. Personnel						
(1) Military (Active)						
(2) Military (National Guard)						
(3) Military (Reserve)						
(4) O&M, Active						
(5) O&M, National Guard						
(6) O&M, Reserve						
(7) Other - PE 0605898E						
(a) Direct Hire, Civilian	.108	.112	.116	.120	.126	.130
(b) Contract	.124	.128	.132	.138	.144	.150
Subtotal Personnel Costs	.232	.240	.248	.258	.270	.280
b. Security Equipment						
(1) O&M, Active						
(2) O&M, National Guard						
(3) O&M, Reserve						
(4) Other						
Subtotal Security Equipment Cost	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COSTS	.232	.240	.248	.258	.270	.280

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ADVANCED RESEARCH PROJECTS AGENCY

SECURITY ACTIVITIES (SA-10, Special Access Programs Oversight)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS						
a. Security Equipment						
(1) Other Procurement						
(2) O&M, Active						
(3) O&M, National Guard						
(4) O&M, Reserve						
(5) Defense Business Operations Funds						
(6) Other	0	0	0	0	0	0
Subtotal Security Equipment						
b. Security RDT&E						
(1) 6.1 (Research)						
(2) 6.2 (Exploratory Development)						
(3) 6.3 (Advanced Development)						
(4) 6.4 (Engineering Development)						
(5) 6.5 (Management & Support)						
Subtotal Security RDT&E	0	0	0	0	0	0
c. Security Construction						
(1) Military Construction appropriation						
(2) O&M appropriation	0	0	0	0	0	0
Subtotal Security Construction	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	0	0	0	0	0	0
TOTAL TOA FOR ARPA.	.232	.240	.248	.258	.270	.280

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ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-11, Policy/Oversight)

MANPOWER

	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
Military Personnel								
a. Officers								
End Strength	0	0	0	0	0	0	0	0
Average Strength	0	0	0	0	0	0	0	0
b. Enlisted								
End Strength	0	0	0	0	0	0	0	0
Average Strength	0	0	0	0	0	0	0	0
c. Total Military								
End Strength	0	0	0	0	0	0	0	0
Average Strength	0	0	0	0	0	0	0	0
Civilian Personnel								
a. Direct Hire								
End Strength	1	1	1	1	1	1	1	1
Workyears	0	0	0	0	0	0	0	0
b. Indirect Hire								
End Strength	1	1	1	1	1	1	1	1
Workyears	0	0	0	0	0	0	0	0
c. Total DoD Civilians								
End Strength	1	1	1	1	1	1	1	1
Workyears	1	1	1	1	1	1	1	1
TOTAL DOD MANPOWER								
End Strength	1	1	1	1	1	1	1	1
Contract Personnel								
Workyears	1	1	1	1	1	1	1	1

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ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-11, Policy/Oversight)

TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
OPERATING & SUPPORT COSTS						
a. Personnel						
(1) Military (Active)						
(2) Military (National Guard)						
(3) Military (Reserve)						
(4) O&M, Active						
(5) O&M, National Guard						
(6) O&M, Reserve						
(7) Other - PE 0605898E						
(a) Direct Hire, Civilian	.054	.056	.058	.060	.063	.065
(b) Contract	.062	.064	.066	.069	.072	.075
Subtotal Personnel Costs	.116	.120	.124	.129	.135	.140
b. Security Equipment						
(1) O&M, Active						
(2) O&M, National Guard						
(3) O&M, Reserve						
(4) Other						
Subtotal Security Equipment Cost	0	0	0	0	0	0
c. Miscellaneous	0	0	0	0	0	0
TOTAL OPERATING & SUPPORT COST	.116	.120	.124	.129	.135	.140

Exhibits SA-11 (Page 2 of 3)

ADVANCED RESEARCH PROJECTS AGENCY
SECURITY ACTIVITIES (SA-11, Policy/Oversight)
TOTAL OBLIGATIONAL AUTHORITY
(Dollars in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001
INVESTMENT COSTS						
a. Security Equipment						
(1) Other Procurement						
(2) O&M, Active						
(3) O&M, National Guard						
(4) O&M, Reserve						
(5) Defense Business Operations Funds						
(6) Other						
Subtotal Security Equipment	0	0	0	0	0	0
b. Security RDT&E						
(1) 6.1 (Research)						
(2) 6.2 (Exploratory Development)						
(3) 6.3 (Advanced Development)						
(4) 6.4 (Engineering Development)						
(5) 6.5 (Management & Support)						
Subtotal Security RDT&E	0	0	0	0	0	0
c. Security Construction						
(1) Military Construction appropriation						
(2) O&M appropriation						
Subtotal Security Construction	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	0	0	0	0	0	0
TOTAL TOA FOR ARPA	.116	.120	.124	.129	.135	.140